



AND TELEVISION

Price 25 Cents

Jan. 1948

★ ★ Edited by Milton B. Sleeper ★ ★



COMMUNICATIONS
DIRECTORY - Part 2
PUBLIC UTILITIES
GEOPHYSICAL
TAXICABS
BUSES
TRUCKS
OIL PIPELINES
HIGHWAY MAINTENANCE
—
LISTINGS REVISED TO
JANUARY 1, 1948

8th Year of Service to Management and Engineering

152-162 mc. Communication Equipment

With the *Power Saver* circuit

That means longer life for . . .

quick-heat tubes

Separate switches for transmitter filament and plate voltages mean less battery drain and greater tube life. This "Power Saver" circuit is only one of the examples of advanced engineering that makes Harvey 152-162 mc. equipment cost less for greater dependability.

RECEIVER MODEL 541

Characteristics:

Frequency Range — 152-162 mc.

Type — Crystal controlled, single conversion superheterodyne FM Receiver.

RF Stages — Two, insuring excellent sensitivity.

Single IF Amplifier — Latest design practices achieve high gain from a single IF without requiring double conversion.

Crystal Diodes — In discriminator and squelch circuits, reduce tube complement, size and weight of the unit.

Oscillator Control — Provision is made for plug-in oven-type crystal when required by operations of the equipment in extreme temperature variations.

Automatic Frequency Control — May be used where necessary for Fixed Central Stations.

Standby Drain — 6 amperes.

Power Supply — AC or DC "Plug-in" Type. No further electrical or mechanical changes required in receiver.

TRANSMITTER MODEL 542

Characteristics:

Frequency Range — 152-162 mc.

Exciter Stages — Latest miniature tubes used.

Tubes — All "Quick-heat" tubes except for Oscillator A.F. Amplifier and the single Phase Modulator.

Final Amplifier — Push-pull, shielded parallel-line tank circuit, with a series-resonant link coupling circuit to antenna gives simple, effective and flexible antenna matching to mobile or fixed antennas.

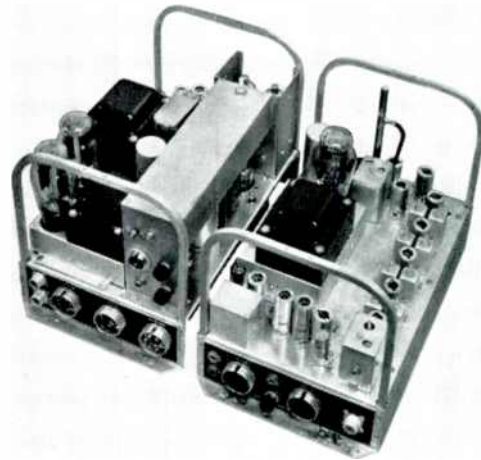
Frequency Multiplication — 48 times, using "Quick-heat" tubes.

Power Output — 30 watts from AC or DC input. Standard deviation and pre-emphasis characteristics incorporated in the transmitter.

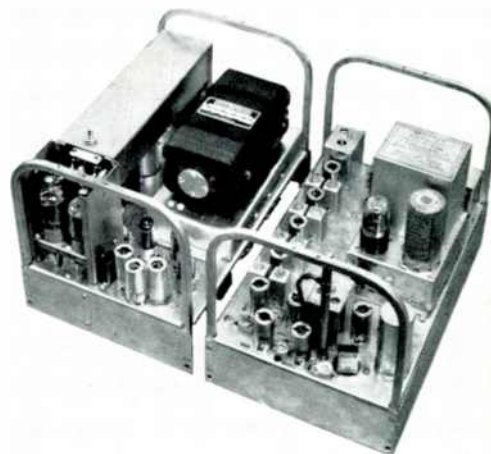
Standby Tube Drain — .45 amperes.

Power Supply — Change from AC to DC operation involves a simple tube change and "plug-in" of the DC power supply.

For detailed information and circuits, see FM and TELEVISION, Nov. 1947 issue: "152- to 162-Mc. Mobile Equipment."



Transmitter (left) Receiver (right) shown with A.C. "plug-in" power supplies.



Transmitter (left) Receiver (right) shown with D.C. "plug-in" power supplies.

HARVEY RADIO LABORATORIES, Inc.
443 Concord Ave., Cambridge 38, Mass.
We want to know how HARVEY equipment will reduce battery costs.

Please send me catalogs and prices on:

☐ 30-44 mc. units ☐ 152-162 mc. units
☐ FM communications test equipment

Name

Address

Station Call

HARVEY RADIO LABORATORIES, INC.
443 CONCORD AVENUE • CAMBRIDGE 38, MASSACHUSETTS

More Results from Advertising WITH A 30% CUT IN YOUR BUDGET

Here's the Proof: If you aren't advertising in *FM* and *TELEVISION* already, you might think you'd have to increase your budget to add this publication. But a sharp pencil and a little simple arithmetic will show that you can actually cut your budget by adding the only magazine devoted exclusively to *FM*, television, and facsimile — the fastest-growing radio markets.

Let's get down to figures. Not only have space rates increased greatly in most publications, but artwork and typography have gone skyhigh. Average costs for a 1-page plate are about \$200, for a $\frac{2}{3}$ -page plate \$150, or about \$100 for $\frac{1}{3}$ -page.

Supposed, for example, you have been using one magazine 12 times a year. Then you not only have the cost of 12 plates a year, but you reach only one group.

If, however, you run 6 times in the paper you have been using, and 6 times in *FM* and *TELEVISION*, you will then lose very little in results from the other paper, and you will gain greatly by adding coverage among "The Men Who Set the Pace the Industry Follows." Here are actual figures on budget reduction, including plate costs given above, showing savings in dollars and in percentage:

	COST: 12 Times Magazine "A"	COST: 6 Times Each FM & TV and "A"	SAVING	SAVING
1 Page	\$6600	\$4450	\$2745	33%
$\frac{2}{3}$ Pg.	4680	3172	1508	32%
$\frac{1}{3}$ Pg.	2680	1760	920	34%

	Magazine "B"	FM & TV and "B"	SAVING	SAVING
1 st Page	\$5720	\$4320	\$1400	24%
<small>13 times in "B", 6 times in FM & TV</small>				

	Magazine "C"	FM & TV and "C"	SAVING	SAVING
1 Page	\$5400	\$3855	\$1545	29%
$\frac{2}{3}$ Pg.	3930	2732	1098	30%
$\frac{1}{3}$ Pg.	2280	1540	720	40%

	Magazine "D"	FM & TV and "D"	SAVING	SAVING
1 Page	\$4800	\$3540	\$1260	26%
$\frac{2}{3}$ Pg.	3480	2550	930	28%
$\frac{1}{3}$ Pg.	2280	1500	780	35%

If these figures do not apply exactly to your advertising schedule, they still indicate that, by revising your old schedule for the coming 12 months, you can gain these three advantages:

1. Reduce your expenditures for trade paper space.
2. Reach the fastest-growing radio mar-

kets, namely, *FM* broadcasting and communications, television, and facsimile.

3. Reach the executives, engineers, upper-bracket retailers, and service organizations in these fields, for whom *FM* and *TELEVISION* is published.

For greater effectiveness from your trade paper advertising, at lower cost, see that your new schedule is adjusted to include:



**AND
TELEVISION**

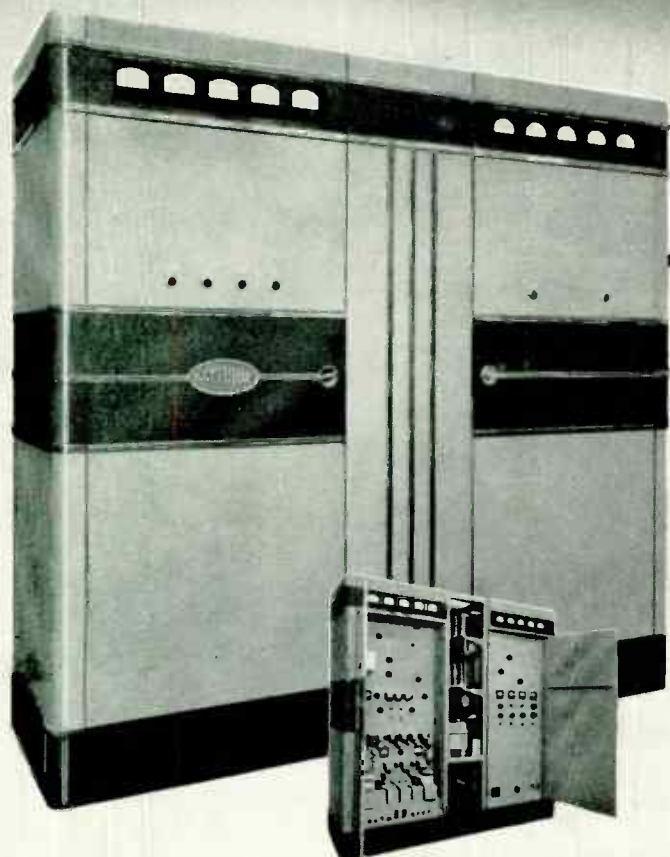
★ ★ Edited by Milton B. Sleeper ★ ★

Publication Office:

Great Barrington, Mass.

NEW YORK: 511 FIFTH AVENUE — VANDERBILT 6-2483

READY NOW



Front view shows arrangement of controls for tuning driver and amplifier. Center lift-off panel has been removed to show accessibility of power supply.

It's a RAYTHEON Responsibility

Backed by Raytheon's complete manufacturing and service facilities . . . when you specify *Raytheon* not only for FM or AM transmitters but for speech input and station equipment — you are teaming up with Raytheon's huge organization devoted to research and manufacture for the Broadcast Industry.



Rear view showing accessibility of chassis, terminal boards, etc.

Look ahead with RAYTHEON

Raytheon's *Integrated Design Policy* lets your station grow with the industry. Start as low as 250 watts . . . step it up with the new 3KW-FM Amplifier and Transmitter . . . use it later as a driver for a 10 KW unit. You're set for the future with no fear of obsolescence.

Write today for complete information and technical details

A New 3 KW-FM TRANSMITTER by RAYTHEON

Ask WLAW-FM about RAYTHEON SERVICE

Marked "OK for shipment" at Raytheon, Waltham, on Thursday, equipment for WLAW's new FM transmitter began feeding programs into their antenna at Burlington, Mass., on Saturday. That's evidence of Raytheon super service made possible by dependable, easy-to-install Raytheon quality equipment.

You'll like its LOOKS

It's clean as a whistle, modern, streamlined — a handsome addition to any up-to-the-minute station. It's true, but hard to believe, that the new Raytheon 3KW-FM Transmitter is the lowest cost reliably made equipment of its class that you can buy.

You'll like its PERFORMANCE

It's easy and quick to tune — requires a minimum of special testing equipment . . . delivers a high quality, stable, hi-fidelity signal . . . operates at an inherently lower noise level. Features *Raytheon* direct crystal control and simplified Cascade Phase Shift Modulation.

You'll like its

EASE OF MAINTENANCE

Simple, conservatively rated circuits . . . easy accessibility . . . *the use of standard, readily obtained, easily replaced parts* — make this Raytheon 3KW-FM Transmitter the easiest, most economical equipment to service and operate.



Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

COMMERCIAL PRODUCTS DIVISION

WALTHAM 54, MASSACHUSETTS

Industrial and Commercial Electronic Equipment, Broadcast Equipment, Tubes and Accessories

Sales offices: Boston, Chattanooga, Chicago, Dallas, Los Angeles, New York, Seattle, Washington, D. C.



AND TELEVISION

★ ★ Edited by Milton B. Sleeper ★ ★

FORMERLY, FM MAGAZINE and FM RADIO-ELECTRONICS

VOL. 8

JANUARY, 1948

NO. 1

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★ ★ ★ ★ ★

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Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit. Payments are made upon acceptance of final manuscripts.



THIS MONTH'S COVER

The New Year's storms that tied up the central and eastern states, and did great damage in the south proved the worth of radio communications for public utility service and repair trucks. With power and telephone lines down, fire alarm systems out, and transportation stopped, 2-way FM paid dividends by speeding the restoration of service.

This month's cover shows a typical installation being made in a hurry on a Cambridge (Mass.) Electric Light Company truck. The Harvey Radio Laboratories transmitter and receiver units, although mounted on the top of the body, are amply protected by a heavy steel case. Operation is in the 152- to 162-mc. band.

RMC TRANSCRIPTION

PLAYER

MODEL TP-16C

(Patents Applied For)



Two-Speed . . .

16-inch . . . Low

Price . . . Portable

. . . Compact . . .

Lightweight . . .

Easy to Carry

*\$124.50 net; Turntable and Case only.

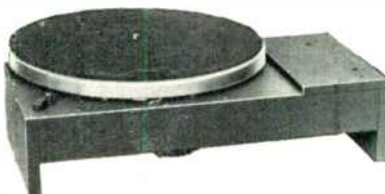
For High Fidelity Reproduction in Radio Auditioning and Program Rooms

- Distinctive in design and quality.
- Finest tone reproduction for superior recorded entertainment.
- Precision-built, expertly engineered, and sturdily constructed for trouble-free performance.
- Switch output impedance: 30,250, and 500/600 ohms.
- Free of wow and rumble. Cast aluminum 16" platter.
- 2 speeds: 78 and 33 $\frac{1}{3}$ r.p.m.
- Fully portable: in carrying position 23" w., 17 $\frac{1}{2}$ " h., 8" d.
- Maximum weight: 38 lbs.
- Constant speed heavy duty motor; silent, smooth operation.

Supplied with or without professional broadcast station Para-Flux Reproducers. Write for Prices.

TURNTABLE CHASSIS TP-16

The same TURNTABLE TP-16 as used in above model is available as a chassis for custom-built radio sets. Also ideal for audition rooms in broadcasting stations for record departments where one or more Turntables can be conveniently installed on shelves. (Portable model TP-16C also can be used for same purpose.)



*\$78.80 net

turntable

chassis only

F.O.B. Port

Chester, N. Y.

AVAILABLE THROUGH AUTHORIZED JOBBERS

Bulletin TP 1, yours for the asking

RADIO-MUSIC CORPORATION

PORT CHESTER • NEW YORK

Export: Recke International Corporation, 13 East 40th Street, New York 16, N. Y.

Entered as second-class matter, August 22, 1915, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Additional entry at the Post Office, Concord, N. H. Printed in the U. S. A.

MEMBER,
AUDIT
BUREAU OF
CIRCULATIONS



All Kinds of OPPORTUNITY Now!

The availability of precision production-made facsimile recorders at a low cost by Alden opens all kinds of opportunities. These opportunities are in home broadcasting, emergency fields, communications, impulse recording and experimentation.

The Alden Products Company engineers are receiving unusual praise from all quarters for the simplicity, interchangeability, and precision qualities of the Alden "four." This recorder is producing the most beautiful pictures in black and in the pleasantly toned Sepia paper manufactured for Alden by Alfax Paper and Engineering Company.

The low frequency requirements of the Alden "four" simplifies the problem of operation over ordinary telephone lines and with existing communication sets, making the recorder capable of universal adoption.

In the home recording field, FM stations are ordering this equipment as a promotional means to increase their listening audience and call attention to their FM stations. That this publicity can be effective and accomplished with a small number of machines, programs are planned for the use of recorders located in semi-public places. A portion of the programs are to be over wire circuits and in addition to the small recorder, the same program is transmitted to the master size recorders. On the Master Bulletin type recorder the program appears four times enlarged with four feet of the program visible for easy reading.

In the communication and emergency field it is being found that the Alden "four" is well-suited to work with existing equipment.

In the impulse recording field its simplicity and high speed of recording are catching the imagination of engineers who find they have an inexpensive way of recording phenomena not readily found in the previous types of conventional recording equipment.

We have literally thousands on our mailing list, some of whose interest is speculative and casual; but who tell us they enjoy our mail releases. If you are in this category and wish to be added to the list, please mail a dollar so that you may receive all mailings automatically, including the immediate mailing of "Questions and Answers Regarding Facsimile."



PRODUCTS COMPANY
Brockton 64FM, Massachusetts

WHAT'S NEW THIS MONTH

1. NOVEMBER SET PRODUCTION
2. 15,000-CYCLE LINES

1. An examination of the accompanying R.M.A. set-production barometer shows a sharp decline of AM sets in November, following an all-time peak the preceding month. This is probably the turning point in the transition from AM to FM. It seems certain that the November AM decline, compared with the steady increase registered by FM, indicates that the October AM record volume will never be reached again.

Probability is that AM production will hover around 1,000,000 sets per month in the first half of 1948, and may drop considerably below that figure in June and July.

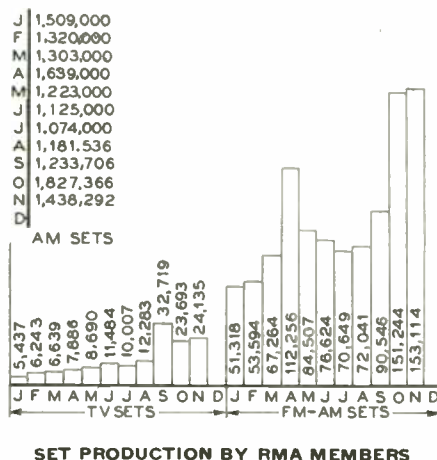
FM production, on the other hand, will gain steadily, in step with the increasing number of new stations going on the air. It will be necessary to revise this estimate upward if, as generally expected, the way is opened for AM-FM program duplication, and unrestricted use of live talent on FM nets when, on January 31, the new AFM contract will probably go into effect.

Television set production, though not

14,674 TV TABLE
4,178 TV CONSOLE
5,283 TV PHONO.

5,660 FM TUNER
1,892 FM CONSOLE
40,198 FM TABLE
105,364 FM PHONO.

NOV. TOTAL		1947 TOTAL	
TV -	24,135	TV -	149,216
FM -	153,244	FM -	983,260
AM -	1,438,292	AM -	14,847,413



SET PRODUCTION BY RMA MEMBERS

yet large in units, amounted to about \$12,000,000, at retail prices, in November, and probably \$75,000,000, for the first 11 months of 1947. This is remarkable, in view of the fact that television broadcasting was only making a start at the beginning of 1947, and that, as the end of the year approaches, 7 cities have only one television station, 2 cities have 2 stations, and 2 cities have 3 stations. Since these 11 sales territories have already proved to be such active markets for television sets, it's anyone's guess what will happen as more transmitters go on the air in 1948, and the availability of good programs is stepped up through the expansion of network facilities.

2. On December 13, the FMA filed a petition with the FCC, asking that the Commission investigate the failure of the Bell System to make 15,000-cycle lines available within a reasonable time, and the apparent discrimination against FM networks in favor of television. On December 19, the FCC announced that a conference will be held by the Commission with the representatives of AT & T and FMA on January 13.

Following is the text of the petition filed by the FMA:

The Petition of the FM Association respectfully represents:

1. That it is a non-profit trade association organized under the laws of the District of Columbia for the purposes of promoting the development of frequency modulation broadcasting, and acting as liaison between its members, the Federal Communications Commission and other agencies and organizations on the continuing over-all problems affecting FM broadcasting.

2. That the FM Association has a membership of 238 consisting of organizations engaged in FM broadcasting, the manufacture of FM receiving and transmitting equipment and in business and professions directly related to FM broadcasting.

3. At the present time, the Petitioner's membership includes broadcasters who are interested in the development and establishment of FM networks on a regional as well as on a national basis.

4. For the purpose of effecting these networking arrangements these individuals and groups have discussed with representatives of the American Telephone and Telegraph Company the establishment of common carrier facilities between central and intermediate points for the proposed network. These requests have embraced the use of wire line facilities with high fidelity and low noise level characteristics which are essential for proper FM operation. More specifically, the American Telephone and Telegraph Company in conferences and correspondence has been requested to furnish infor-

(CONTINUED ON PAGE 14)

FM AND TELEVISION

NEW SKYWAYS —FOR TELEVISION —FOR TELEPHONE



ON NOVEMBER 13, the Bell System demonstrated its new experimental radio relay system between New York and Boston, bringing television within reach of vast new audiences.

The tower you see here is part of it. It's one of seven similar structures which relay microwaves between the two cities, carrying television programs with high fidelity. This new system will, of course, be used for the transmission of Long Distance telephone calls and radio programs.

Used in conjunction with the Bell System's coaxial cable, the new radio relay system now makes it

possible to bring television to a potential audience of some 25,000,000 people along the eastern seaboard. And already work is under way on additional Bell System radio relay projects which will link New York and Philadelphia and extend west all the way to Chicago.

The Bell System may be relied upon to provide the most efficient, dependable facilities for the transmission of communications.

BELL TELEPHONE SYSTEM



Simple New *Solderless* Couplings Maintain Constant 51.5 Ohm Impedance



ANDREW *Flanged* COAXIAL TRANSMISSION LINE FOR FM-TV

Offering the dual advantage of easy, solderless assembly and a constant impedance of 51.5 ohms, this new ANDREW FM-TV line is available in four diameters. Each line fully meets official RMA standards. It also is recommended for AM installations of 5 Kw or over.

Fabricated in twenty foot lengths with brass connector flanges silver brazed to the ends, sections are easily bolted together. A circular synthetic rubber "O" gasket effectively seals the line. Flux corrosion and pressure leaks are avoided. A bullet-shaped device positively connects inner conductors.

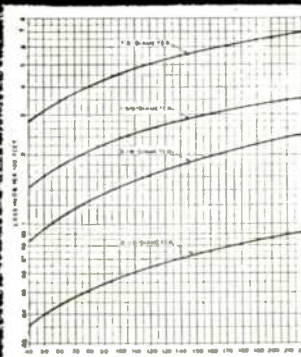
Close tolerances are maintained on characteristic impedance in both line and fittings, assuring an essentially "flat" transmission line system.

Mechanically and electrically better than previous types, this new line has steatite insulators of exceptionally low loss factor. Both inner and outer conductors of all four sizes are of copper having very high conductivity.

Flanged 45 and 90 degree elbow sections, and a complete line of accessories and fittings available.

Better be safe, than sorry. Avoid costly post-installation line changes. Get complete technical data, and engineering advice, from ANDREW now.

ANDREW



ATTENUATION CURVE

shows total loss plus 10% derating factor to allow for resistance of joints and deterioration with time.
Four diameters available: 6 1/8" — 3 1/8" — 1 3/8" and 7/8".

Andrew

CORPORATION

363 EAST 75th STREET • CHICAGO 19

Pioneer Specialists in the Manufacture of a Complete Line of Antenna Equipment

TELENOTES

Cincinnati: Crosley station WLWT will have an effective radiated power of 50 kw. when the permanent 5-kw. television transmitter goes into operation with a 5-bay antenna 571 ft. above ground.

TV Demonstration: On December 17, CBS staged a demonstration in Boston at Filene's department store, bringing in WCBS-TV programs, originating in New York, over the AT & T relay system. Stores in Boston are already selling television kits, and taking orders for receivers.

Foreign Films: CBS has signed agreements with Film Polski, a Polish newsreel firm, and with the Australian News and Information Bureau, government film distributor, under which foreign films will be made available for telecasting here.

Jack Popple: TBA president, discussing an industry code for television broadcasting: "As an art, television has barely got its feet wet. It would seem foolhardy to create a rigid set of standards based on the operation of only a handful of stations. Furthermore, among the broadcasters on the air, there has been a consciousness borne of public responsibility that has been ever-present in the minds of the operators."

Warning: If you use the flat, plastic-ribbon type of lead for your television or FM antenna, don't tape it against a metal mast. If you do, you'll lose most of your signals. Space it at least 3 ins. from any metal with wooden blocks. You can run coaxial cable against anything, however, without affecting the signals.

WBT: Jefferson Standard Broadcasting Company, Charlotte, N. C., has filed for a television transmitter to be installed at Spencer Mountain, site of their FM station. Directors have approved the investment of \$500,000 in this new venture. Operation will be timed with AT & T's extension of network facilities.

TBA Awards: Honored by awards at the Television Broadcasters Association clinic, New York City, on December 10, were Dr. Frank G. Back, who developed the Zoomar lens for television cameras; William C. Eddy of WBKB for engineering the South Bend-Chicago relay; Paul M. Hahn for his skillful use of commercial techniques in American Tobacco programs; and Ben R. Donaldson for his experiments with commercial programs for the Ford Motor Company. Also cited was John H. Platt, Kraft Food shows.



IS STILL THE HOTTEST LINE IN THE INDUSTRY



*That's Because of the
Value-Giving, Sales-Making
Features Made Possible By
Zenith's Policy of*

RADIONICS EXCLUSIVELY

FIRST IN FEATURES

Watch shoppers on any radio sales floor. What set catches the interest of the crowds?—a Zenith, of course! That's because *every* model in the Zenith line is packed with features that actually *mean* something—features that reflect the design and engineering "know-how" developed during Zenith's years in the industry—features that insure *value*.

FIRST IN DEMONSTRABILITY

Zenith radios and radio-phonographs are *easy* to sell, because their features are the kind that you can actually *demonstrate*. The Cobra Tone Arm, for example, permits the most dramatic tone arm demonstration ever made. The Zenith "Radiorgan," the Silent-Speed Record Changer, the big, black dial, the Zenith Wavemagnet—all these are features you can show . . . features your customers will notice and want.

FIRST IN PERFORMANCE

From the original engineering blueprint to the finished sets that come out of the final testing booth, every Zenith is built to *work* . . . built with all the skill, the knowledge, the *pride of achievement* that marks this organization. The final test of every radio is how it *performs* . . . and Zeniths are built to pass that test with flying colors. Hundreds of thousands of well-satisfied Zenith owners attest to *that*.

ZENITH RADIO CORPORATION

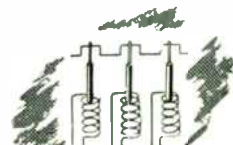
6001 W. DICKENS AVENUE • CHICAGO 39, ILL.

January 1948 — formerly *FM*, and *FM* RADIO-ELECTRONICS

ONLY ZENITH OFFERS SALES FEATURES LIKE THESE



RADIONIC
COBRA TONE ARM



ARMSTRONG F-M



WAVEMAGNET



RADIORGAN



SILENT-SPEED RECORD CHANGER



3-GANG CONDENSERS



NEW SUPER-SIX TUBE



80% MORE POWERFUL
PHONOGRAPH MOTOR

PRODUCTS & LITERATURE

So many new instruments, components, and materials are being brought out that space does not permit us to publish illustrated descriptions of them all. Accordingly, rather than selecting a few each month, we have established this new department of Products & Literature so that a great number of brief descriptions can be published. From these, you can select items which interest you, and send for catalogs or bulletins. We'll appreciate it if you will mention FM and TELEVISION in your requests.

TV Frequency Monitor: For monitoring video frequency only. Low-pass filter eliminates picture line-frequency, and allows a maximum deviation of ± 12 kc. to be monitored. Designed for single-channel operation on 1.6 to 220 mc., with .001% accuracy. Type 1175-BT — Bulletin RE, General Radio Co., Cambridge 39, Mass.

Miniature Voltage Regulator: RCA types OA2 and OB2 are cold-cathode, glow discharge tubes, the former maintaining a DC operating voltage of approximately 150 volts, and the latter 108 volts. — Bulletin AB11, R. C. A. Tube Dept., Harrison, N. J.

Sweep Generator: Designed specifically for servicing FM receivers. Provides 88- to 110-mc. signal, unmodulated or amplitude-modulated, for aligning RF, mixer, and oscillator circuits, and frequency-modulated output on 8.3 to 10.8 mc. with adjustable sweep width for IF alignment. Contained in portable case. — Bulletin RF, RCA Victor Division, Camden, N. J.

Iconoscope Film Pickup: Complete system for televising film, comprising film pickup units and control consoles. Usual installation has two pickup units, and two console sections, each controlling one camera. — Bulletin AFB, A. B. DuMont Laboratories, Inc., 42 Harding Ave., Clifton, N. J.

Tube Manual: New edition of the RCA tube manual has been brought up to date and enlarged to include data on FM, television, and miniature tube circuits. Technical sections cover ratio detectors, discriminators, limiters, multivibrators, and resistance amplifiers. 256 pages, price 35¢. — Manual RC-15-FV, RCA Tube Dept., Harrison, N. J.

Omnidirectional Antenna: Provides for non-directional FM or TV reception. Folded dipole in the shape of an S gives increased

reception in what are the null directions of a straight dipole. Constructed of $\frac{3}{8}$ -in. aluminum tubing, carried on a 5-ft. mast. — Bulletin AC, Technical Appl. Corp., Sherburne, N. Y.

Test Meter: High-sensitivity tester for tubes, sets, and batteries, with a 35-range meter for AC, DC, and resistance, described as a complete, portable test laboratory. — Bulletin III, Precision Apparatus Co., Inc., 92-27 Horace Harding Blvd., Elmhurst, N. Y.

Antennas: Double-deck dipoles and reflectors for home FM or TV reception. Rated at 5 db. gain in line of reception, and 15 db. rejection of signals from rear. — Bulletin FMC, Camburn, Inc., 32-40 57th Street, Woodside, N. Y.

FM Tuner: For use with the audio system of an AM receiver, or with a high-quality amplifier and speaker. Audio output is rated flat within 2 db. from 50 to 15,000 cycles, with 3 volts RMS output at minimum usable signal input, up to 15 volts. Operates on 105-125 volts, 60 cycles. Tubes: two 6AG5, two 6BA6, two 6C4, one 6AL5, and one 6X5GT/G. Price \$57.50. — Bulletin FMR, Meissner Mfg. Div., Maguire Industries, Mt. Carmel, Ill.

Crystals: New bulletin gives technical data and dimension drawings of 22 standard types of crystal mountings, both with and without temperature control. — Bulletin BC, Bliley Electric Co., Erie, Pa.

Heavy Duty Sockets: Three new types, designed to save space in equipment where tubes are mounted vertically on vertical panels. Two types are for medium 4-pin UX bases, and the third for super-jumbo and industrial 4-pin bases. Connections can be made at the rear of the panel. All three types have solderless screw terminals. Bulletin CPA, American Phenolic Corp., Chicago 50, Ill.

Aircraft Antennas: An 8-page booklet reviews research by the Army, Navy, and commercial airlines on the nature and elimination of precipitation static on aircraft antennas. A detailed description is given of the latest methods of overcoming this source of trouble. — Booklet DA, Dayton Aircraft Products, Inc., 342 Xenia, Dayton, Ohio.

FM Receiver for Schools: Table model FM receiver, with 2 short-wave bands, complete with 8-in. speaker, is designed for group-listening in schools. Overall construction is rugged, so that receiver can be moved frequently without being harmed. Price \$189.95. — Electronics Dept., General Electric Co., Syracuse, N. Y.

Sound Pressure Measurement: Multipliers of non-discriminating frequency charac-

teristics for extending the upper range of GA-1002 and GA-1004 sound pressure measurement systems. Thus measurements can be made with the former from 20 to 20,000 cycles, and with the latter up to 100,000 cycles. — Bulletin MM, Massa Laboratories, Inc., 3868 Carnegie Ave., Cleveland 15.

Recording Instruments: Sixteen-page booklet on recorders entitled "Operation Recorders — Their Selection and Use." A complete list of applications is included. — Bulletin 2470, Esterline-Angus Co., Inc., Box 596, Indianapolis 6.

Test Meters: A cabinet assembly of 6 meters, with bottom compartments for leads and accessories, described as a "complete electrical laboratory". Meters cover a wide range of AC and DC voltage and current measurements. Also furnished are a 50-microampere meter with 20,000 ohms per volt, and a rectifier type AC meter of 1,000 ohms per volt which can be used as a db meter from -10 to +55 db. Cabinet is 34 by 17 by 9 ins. — Bulletin EL, Simpson Electric Co., 5200 Kinzie St., Chicago.

TV Receiver: Console model has automatic phonograph, FM, AM, and short-wave reception, and direct-view television. Very neat trick is 60° swivel picture-tube mounting, called "Swing-a-view". Thus, if the most suitable place to put the console in a living room is not the best location for straight out televising, the tube can be swung to a convenient angle. Price \$795. — Bulletin SA, Crosley Div., Avco Mfg. Corp., Cincinnati, Ohio.

Pocket Signal Tracer: About the size of a thick fountain pen, has multi-vibrator operated by a penlite dry battery. Current drain .15 amp. For setting BC padder, and checking RF, IF, and AF circuits, and opens in wiring. — Bulletin 12, Radex Corp., 2076 Elston Avenue, Chicago.

Television Test Pattern: AC-operated television receiver test unit, connected to TV receiver, generates a pattern on the picture tube of 12 horizontal lines and 16 vertical lines. Since this pattern can be used to adjust vertical and horizontal linearity, service work is made independent of broadcast station test-pattern transmission, and receiver can be checked on all channels at one time. Model 5072 Cross-hatch Generator, \$39.95. — Bulletin 4096, Philco Corporation, Philadelphia.

Cueing Attenuator: Features a switching mechanism to transfer attenuator input to a pair of separate output terminals for cueing purposes, facilitating program switching and fading in "on cue". No increase in diameter of attenuator, since switch is at the rear. Detent action can be furnished. — Bulletin IIB, Shallcross Mfg. Co., Collingsdale, Pa.

Quiet as a Moonbeam Falling on Velvet

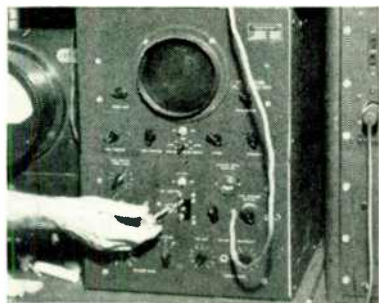
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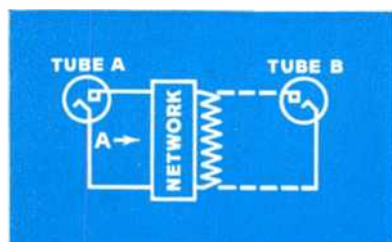
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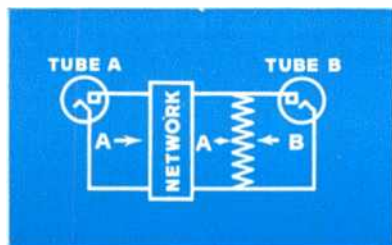
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How the Doherty Circuit pays off for Broadcasters

DOHERTY CIRCUIT



CONDITION 1: Nearly zero modulation, so amplifier has to handle carrier wave alone. Tube A is sufficient and—seeing just the right impedance in network—operates at maximum efficiency. Tube B, not needed, lies idle.



CONDITION 2: Carrier being modulated. Tube B, now needed, kicks in, adding its quota of power to handle the increased load and changing the impedance so that Tube A also steps up its output. Both tubes work to full capacity and at high efficiency.

The Doherty Circuit for AM broadcast transmitters was the first to achieve *high efficiency and economy* and still retain the following important advantages of *linear and grid bias modulated* power amplifiers:

- (1) **A simple tube complement**—no high-power audio tubes required
- (2) **No modulation transformer required**—savings in space and apparatus
- (3) **Freedom from transient or over-modulation surges**—can be heavily overmodulated at any audio frequency for long periods without damage
- (4) **Adaptability to large amounts of feedback** derived from the final output envelope, resulting in low noise, low harmonic distortion, and low intermodulation distortion over wide variations in tube characteristics and circuit adjustment
- (5) **Negligible carrier shift**, assuring full utilization of the assigned carrier power of the station

Gearing tubes to circuits

How a tube acts in a circuit depends, of course, upon the *impedances* which

face it in the circuit. So getting the most out of tubes is a matter of getting the right impedances.

Like pre-Doherty linear amplifiers, the Doherty *High Efficiency* Amplifier Circuit has two tubes. *Unlike* them, it has a network which automatically changes impedances to best meet changing needs. Both tubes receive the signal, but—when the carrier alone is on—only *one* tube is operative. The second tube uses no power. Not until modulation is applied, raising the input voltages on both tubes, does the second tube start up. It then does two things: it contributes more power to meet the added load, and it automatically changes the impedance faced by the first tube so as to throttle it up to full output, too.

For the Broadcaster, this means that the Doherty Circuit consumes only *half the power* required by old style linear amplifiers—a real triumph in circuit engineering.

It is just one of many Bell Telephone Laboratories developments which have contributed to improved efficiency, greater economy and higher quality in communications.



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The 5 KW AM transmitter, like the 1KW and 50 KW, has the famous Doherty Circuit. Eleven years of experience proves this *High Efficiency* amplifier operates continuously for long periods with no need for retuning.

ONLY Western Electric
AM broadcast transmitters
have the Doherty Circuit
1KW...5KW...50KW

Today the Doherty Circuit is being used by hundreds of broadcast stations—making possible the use of smaller circuit elements, saving space, giving increased stability and greater ease of adjustment, and reducing the outlay for auxiliary equipment.

Other features

In Western Electric 1, 5 and 50 KW AM transmitters, you also get two other famous Bell Laboratories developments—stabilized feedback and grid bias modulation. These, to-

gether with the Doherty Circuit, are your assurance of superlative performance at rock-bottom operating cost!

Get full details

If you're thinking about a new AM transmitter, remember this: *only* Western Electric has the Doherty *High Efficiency* Circuit—unmatched today in performance, dependability, and economy! For full details, call your local Graybar Broadcast Representative or write Graybar Electric Co., 420 Lexington Ave., New York 17, N. Y.



The 1 KW AM transmitter, with the Doherty Circuit, is extremely compact—requires floor space only 44" wide by 42" deep.

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FOREMOST



SX-43

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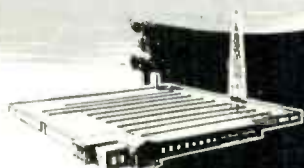
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WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 4)

mation regarding (1) the establishment of facilities with 15,000-cycle fidelity and (2) the rates that would be charged for such service.

5. Despite frequent requests for information of this nature considerable delay has occurred in the furnishing of this data and in advising broadcasters regarding the plans of the American Telephone and Telegraph Company for the establishment of regional and national networking facilities for FM users. As a result of this delay the progress of FM broadcasting has been considerably retarded and the creation and development of new networks has been impeded.

6. Specifically, a recitation of the facts as they relate to the Continental Network will illustrate the delays incident to the establishment of this network service.

(a) In letters of February 14 and March 12, 1947 as well as in discussions between those intervals, representatives of the Continental Network advised American Telephone and Telegraph Company representatives (Long Lines Department) of their interest in the establishment of 15,000-cycle lines. In an acknowledgment of March 21, 1947 attached as *Exhibit A*, Mr. Harry Jeavons, Division Commercial Manager, advised in part: "— we are currently reviewing the entire situation involving the provision of 15-ke. program transmission service channels. Upon completion of this review we shall be glad to discuss the matter with you further."

Subsequently, in a letter of May 16, 1947, attached as *Exhibit B*, the same party advised: "Your inquiry concerning 15-ke. channel for the Continental Network is being reviewed and we shall advise you as promptly as possible as to the points which could be served and the costs involved."

It was not until August 13, 1947 that definite information on this subject was furnished, as set forth more definitely in *Exhibit C*.

7. Section 202 of the Communications Act of 1934 provides that

(a) "It shall be unlawful for any common carrier to make any unjust or unreasonable discrimination in charges, practices, classifications, regulations, facilities or services for or in connection with like communication service, directly, or indirectly, by any means or device, or to make or give any undue or unreasonable preference or advantage to any particular person, class of persons, or locality, or to subject any particular person, class of persons, or locality to any undue or unreasonable prejudice or disadvantage.

(b) Charges or services, whenever referred to in this Act, include charges for, or services in connection with, the use of wires in chain broadcasting or incidental to radio communication of any kind."

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WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 14)

It is Petitioner's contention that the American Telephone and Telegraph Company has discriminated against FM broadcasting and has preferred other broadcast services as will be shown hereafter.

8. At the time that the American Telephone and Telegraph Company officials were reviewing the establishment of 15,000-cycle facilities for FM networks (*Exhibit B*) there were 220 FM stations in operation and the Commission had authorized an additional 630 stations which were in various stages of construction. By comparison at or about that time 10 television stations were in operation and the Commission had authorized an additional 55 stations.

9. It can be seen from the above that actual and potential FM users of common carrier facilities outnumbered the same category of television users by a ratio of approximately 12 to 1. Nevertheless, no definite plan for the establishment of FM network lines had been formulated by American Telephone and Telegraph Company, but a specific and detailed plan had been announced for television networks at a public hearing held by the Commission on June 9, 1947.

10. At that informal hearing concerning intercity television program transmission, Mr. H. H. Nance, Long Lines engineer, testified in detail regarding the establishment of television networks. In his testimony he included plans for intercity connections as follows:

(1) NEW YORK AND WASHINGTON: "The two existing television circuits between New York and Washington, of course, will continue to be available."

(2) PHILADELPHIA AND BALTIMORE: "Television terminal equipment is scheduled to be added to these circuits at Philadelphia and Baltimore to permit either the reception or origination of programs at both of these points. This additional terminal equipment, which will expand the usefulness of the two New York-Washington television facilities, is expected to be available in time for the football season this fall."

(3) NEW YORK AND BOSTON-PROVIDENCE: "New York and Boston are expected to be interconnected this fall by means of an experimental radio relay system between the two cities. A branch to connect Providence to these circuits could be installed in 1948."

(4) NEW YORK AND ALBANY-SCHENECTADY: "A coaxial cable from New York to Albany is under construction and is scheduled for completion by about the end of this year. Using this cable, Schenectady may be added to the television network by the summer of 1948, if required. Thus, the major cities of the eastern seaboard area from Boston to Washington and Richmond may be provided with net-

(CONCLUDED ON PAGE 54)

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THE MICROWAVE HANDBOOK

Chapter 1: The Importance of Microwaves—Basic Considerations and Characteristics

SAMUEL FREEDMAN*

INTRODUCTION

MORE and more engineering man-hours are being devoted to research in the radio spectrum from 300 to 30,000 mc., and an increasing number of project groups are at work on the development of equipment to utilize these frequencies.

While the radio industry as a whole has not yet felt the impact and significance of progress in the field of microwaves, it is none too soon for everyone in management, engineering, production, sales, and maintenance to become familiar with the fundamental techniques of microwaves.

The reason is obvious. Already, bands allocated to various services are crowded up to 300 mc. In this part of the spectrum, assuming that the average width of each channel is 100 kc., there is only room for 3,000 channels, while from 300 to 30,000 mc., there is room for 148,500 channels 200 kc. wide.

Give a little thoughtful consideration to these figures, and you will see why, in the not-distant future, radio communications will move rapidly into the new frontier above 300 mc.

At the end of World War 2, little had been accomplished in microwave application except in military uses, principally for radar. Now, with its conversion to peace hardly completed, commercial relay systems suitable for multiplex telephone, telegraph, printer, facsimile, aural broadcasting, and television are in operation. Moreover, they have proved so successful that they give promise of replacing many wire circuits used for such services.

Television broadcasting, to which the band from 480 to 920 mc. has been assigned already, will move up to these frequencies sooner than is generally realized. That this must be so is clear from the fact that the low-band channels now in use are not sufficient to accommodate the applications already filed in some cities. At the present rate of filing, it appears that the number of low-band channels may be exhausted long before commercial high-band equipment is available. Then, with removal of the 6-mc. limitation imposed by low-band television, we can expect a shift from 525-line definition to perhaps 1,000-line picture quality.

Aviation will also benefit from the development of microwave blind-landing systems, and means for safe flying.

These are but a few of the new services to be performed by microwaves. What will

follow will represent a far greater degree of expansion that has come in the utilization of frequencies up to 300 mc., even going back to the days when the spark transmitter, now banned from the ether,



FIG. 1. MICROWAVE TRANSMITTER FOR TRANSMITTING A TELEVISION PROGRAM FROM THE WALDORF TO WNBT

was the farthest frontier of radio development.

Of course, there are limitations in the use of microwaves. While high effective radiated power can be developed for beam transmission, it is obtained through the use of reflectors. So far, omnidirectional transmission is limited to a few watts. As frequencies increase, propagation approaches the characteristics of light. Until we learn to bend the waves, so they will follow the curvature of the earth, microwaves can not be used for long-distance communication.

Probably these and other limiting factors will be overcome as the industry makes increasing use of microwaves.

1.1 Microwave Spectrum ★ For reference pur-

poses, the radio spectrum is divided as follows:

Wavelength	Frequency	Official FCC Abbreviation
VERY LONG WAVES		
inf. to 10,000 m.	0 to 30 kc.	VLF
LONG WAVES		
10,000 to 1,000 m.	30 to 300 kc.	LF
MEDIUM WAVES		
1,000 to 100 m.	.3 to 3 mc.	MF
SHORT WAVES		
100 to 10 m.	3 to 30 mc.	HF
VERY SHORT WAVES		
10 to 1 m.	30 to 300 mc.	VHF
ULTRA SHORT WAVES		
100 to 10 cm.	.3 to 3 kmc.	UHF
SUPER SHORT WAVES		
100 to 10 mm.	3 to 30 kmc.	SHF

The microwave band includes the ultra short and super short waves, from 1 m. down to .01 m., or 300 mc. up to 30,000 mc.

Because of the short wavelengths in the microwave region, it is customary to express wavelength in centimeters or millimeters, and because of the high frequencies, it is more convenient to express frequency in kilomegacycles. A kilomegacycle is 1,000,000,000 cycles, or 1,000 megacycles.

The total amount of channel space in the bands up to 300 mc. is only .1% of the region below the infra-red band, which starts at 300 kmc. The spectrum above radio frequencies is divided in this manner:

SPECTRUM FREQUENCY

Infra-Red: 300 to 375,000 kmc.

Light: 375,000 to 750,000 kmc.

Ultra-Violet: 750,000 to 22.5 million kmc.

X-Rays: 22.5 to 45,000 million kmc.

Radio Activity: 45,000 to 270,000 million kmc.

Cosmic Rays: Infinity

It is interesting to note that, although we generally refer to the lower bands in terms of frequency rather than wavelength, in the case of microwaves the use of wavelength designations is widely employed. The reason is that the mechanical dimensions of microwave plumbing are directly related to the length of the electrical waves it is designed to handle, whereas, below 300 mc., lumped inductances and capacitors do not bear a similar relationship to the resonant frequency of the circuits in which they are used.

1.2 Uses for Microwaves ★ Microwaves hold the key to the further expansion of radio communications and new types of remote-control devices. Among the advantages afforded by microwaves are:

* Microwave Engineer, DeMornay-Buird, 475 Grand Concourse, New York 51, N. Y.

1. An enormously wide band of frequencies available for new services.

2. Ability to accommodate the multiple use of any frequency channel, because of the limited range of transmission.

3. Adaptability to the use of sharply-focused antenna reflector systems, offering advantages in narrow-beam transmission and high energy concentration, minimum channel occupancy, and relative privacy.

4. Accommodation to high-definition black-and-white television or color television occupying 20-mc. channels.

5. Space for wide-band FM relays to handle multiplexed services. In this connection, it should be remembered that the relative advantage of FM over AM is considered to be equal to 1.73 times the deviation ratio squared. In all probability, when television moves into the 480- to 920-mc. band already assigned to it by the FCC, the video as well as audio signals will be transmitted by FM.

6. Also pulse types of communications can be used in the microwave band. These systems produce high peak power from transmitters of low average power. They also provide multiplex operation by employing variations of pulse rate and pulse interval timing.

7. Equipment does not require conventional inductances and capacitors, their equivalents being provided in the mechanical construction.

8. Miniature equipment can be employed, offering convenience advantages from reduced weight and physical size.

9. A large change in frequency or channel selection can be obtained from a given set of components, since they require only a slight adjustment for a wide frequency shift.

10. Extremely small and inconspicuous antennas can be used for many communications purposes.

The simplest microwave transmitter need comprise no more than a tube to generate oscillations, and a hollow pipe as a tuning circuit and to propagate the energy directly into space.

Perhaps the most promising field for microwave applications is in relay communications. This is the only means now available for transmitting and relaying intelligence requiring channels exceeding 6 to 10 mc. in width. In fact, except for the costly coaxial cable and wave-guide pipe line, there is no other method for handling intelligence on channels exceeding 15 kc. in width. That is about the present-day limit of good, open wire lines.

During the war, for reference purposes the microwave spectrum was divided into 5 bands, identified by letters. Since the practice will probably be continued, the designations are given below:

Band	Frequency	Wavelength
P	225 to 390 mc.	133.3 to 76.9 cm.
L	390 to 1,550 mc.	76.9 to 19.37 cm.
S	1,550 to 5,200 mc.	19.37 to 5.77 cm.
X	5,200 to 11,000 mc.	5.77 to 2.75 cm.
K	11,000 to 33,000 mc.	2.75 to .909 cm.

These are the designations used particularly in reference to radar equipment and tubes employed to generate microwaves.

1.3 Propagational Behavior ★ Basic calculations for microwave propagation must assume transmission in unobstructed space. In this respect, the propagation characteristics are similar to light under certain conditions.

Specifically, the range in miles over a smooth earth is

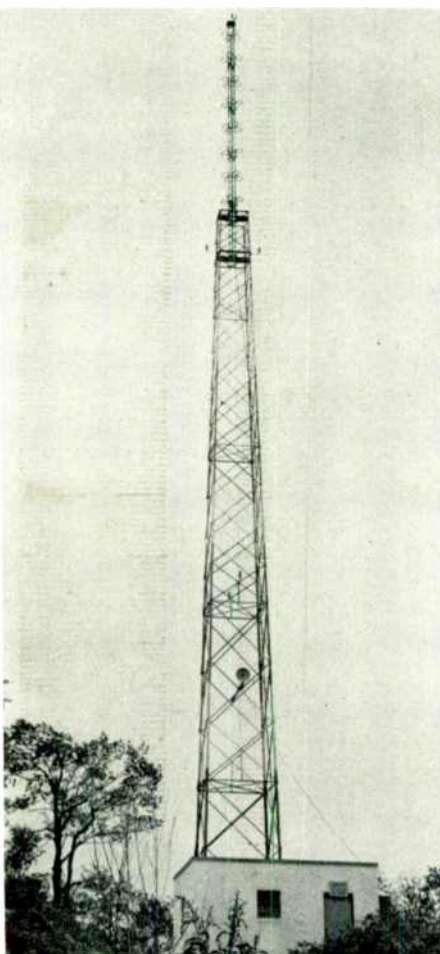


FIG. 2. REFLECTOR ON THE FM TOWER AT WINC-FM, USED TO RECEIVE MICROWAVE RELAY TRANSMISSION FROM THE STUDIO

$$\text{Distance, miles} = 1.4\sqrt{\text{Antenna Height, ft.}}$$

When the horizon is obstructed, such as may be the case inside a room, elevator, interior of a subway train, or inside a tunnel, microwaves behave like light. They may then travel from such enclosures into others, or into open space, by reflection. Reflections take place from wall to wall as if the microwave energy were a beam of light, and every obstruction a mirror of that shape and relative dimensions.

The net result is that microwaves can provide communication under many conditions impossible for conventional radio frequencies alone, or for light alone.

When microwave signal energy strikes a physical barrier in its path, it is reflected by that object at angles depending on the contour of the obstruction. It will then

continue in such useful or un-useful directions until it encounters another obstruction. Further reflections will take place in new directions. In practice, some of the energy (normally a useful amount) will continue onward to a distance greater than possible for straight-path communication on the VHF band.

Under unfavorable conditions, the energy may return to the source (basis of radar operation) or some degree of energy cancellation may take place at the receiving point because of the arrival of amplitudes and phases of the energy by paths of different lengths.

Microwaves are attenuated more rapidly than the lower radio frequencies. This is due to the fact that the shorter wavelengths approach the dimensions of particles in fog, rain, snow, and gases. This is increasingly pronounced as the frequency is increased. However, in practice, microwaves often make use of natural wave guide paths. Any two pronounced walls, such as the ionosphere and the earth, serve for sky-wave type of operation. For example, microwaves may be reflected forward by bouncing between two density zones caused by temperature or atmospheric stratification of any kind. They may even find an atmospheric duct or stratified layer and travel in it by reflecting back and forth on its diameter.

Generally, if microwaves do not reach their destination by direct path, they may conceivably get there by reflection. Maximum energy is reflected when the object encountered is of maximum conductivity. The least reflection takes place over flat uniform terrain of high ground resistance, with uniform atmospheric conditions.

1.4 Circuit Behavior ★ While the same fundamental laws apply to microwaves and the lower frequencies alike, certain seemingly contradictory effects are encountered.

1. Lumped inductance, such as a coil, cannot be used. Any inductance or conductor, however low its DC resistance, increases in reactance with increased frequency to the point where it becomes virtually an insulator.

This is in accordance with the formula for inductive reactance

$$X_L = 2\pi fL$$

where X_L = resistance in ohms
 f = frequency in cycles
and L = inductance in henries

Thus, for example, a 1-millihenry coil would have an inductive reactance of 62,832 megohms at 10,000 mc.

2. Lumped capacity cannot be used. Any condenser, however high its DC resistance, decreases in reactance with increased frequency to the point where it becomes virtually a short circuit.

This is in accordance with the formula for capacitive reactance

$$X_C = \frac{1}{2\pi fC}$$

where X_C = resistance in ohms

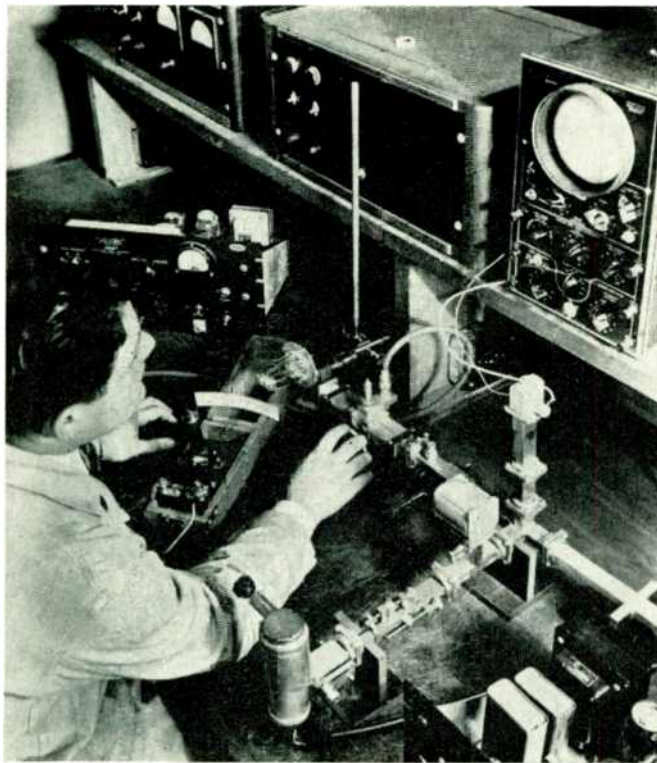


FIG. 3, LEFT: MICROWAVE TEST EQUIPMENT SETUP AT PHILIPS LABORATORY. FIG. 4, RIGHT: MICROWAVE RELAY ANTENNA AT WBT-FM

and $C = \text{capacity in farads}$

Thus, for example, a .001-mfd. condenser would have a capacitive reactance of .016 ohm at 10,000 mc.

3. The total reactance due to lumped reactances in a microwave circuit would be of a very high order, as shown by the formula.

$$X = X_L - X_C$$

where $X = \text{total reactance in ohms.}$

That is because the inductive reactance is so extremely high, and the capacitive reactance is so extremely low.

4. Similarly, values of Q in microwave circuits are of a high order, since Q is the ratio of AC to DC resistance. Where a Q of 10 to 100 represents a high figure of merit in circuits operated at lower frequencies, microwave circuits may have a Q of 1,000 to 10,000. With careful design, the Q may be much higher at the upper end of the microwave band.

5. At microwave frequencies, the skin effect becomes pronounced to the point where the current is carried by only the first few millionths of a meter of the thickness of the conductor. A conductor with a cross-section large enough to present a very low resistance to DC behaves, therefore, as if it had a much smaller cross-section when carrying microwave frequencies. For this reason, microwave components are generally plated with silver or gold.

6. Quartz crystals used in circuits at the lower frequencies have a Q of about 2,000. Such an order of Q is much higher than can be developed by the circuitry. On microwaves, a simple hollow pipe, with both ends closed, can develop a Q many times higher than that of the crys-

tal. Therefore, cavities make an ideal substitute for crystals. Moreover, they function without the need of multiplication stages.

7. Since it is inefficient and virtually impossible to send appreciable microwave energy over wires, a different technique is necessary. A hollow pipe or wave-guide of rectangular cross-section is used to carry energy between two points such as an antenna and its transmitter or receiver. In this case, energy travels down the wave-guide by reflection between opposite walls provided they are separated by a distance in excess of one-half a wavelength. For example, a pipe having a wall separation in excess of 2 ins. will carry energy at 3,000 mc. Since

$$1 \text{ meter} = 39.37 \text{ in.,}$$

the wavelength at 3,000 mc. is .1 meter or 3.9 ins. Thus 2 ins. is greater than one-half wavelength at 3,000 mc.

8. Energy can be focused by small reflectors, provided the dimensions of the reflector are substantially greater than 1 wavelength.

9. Low-power equipment can give the effect of much greater power at low frequencies, provided it is concentrated in a beam. This is due to the fact that the use of highly directional antennas is impractical at low frequencies, or long wavelengths, because of their physical dimensions.

For example, a 30-in. reflector at 10 cms. or 3,000 mc. can produce a beam about 8° wide, corresponding to an energy concentration of 400 times. If both transmitter and receiver employ such a reflector, the energy concentration or effective power gain is 400².

Thus a .1-watt transmitter with a gain of 160,000 times becomes, in effect, a 16-kw. transmitter.

The principal microwave problem has been that of designing vacuum tubes for generating and amplifying the extremely high frequencies required. The principal tubes which have been employed are the magnetron, where an external magnetic field is substituted for the grid; the klystron, where electrons from the cathode travel at different velocities to produce bunching effects; and the disc-seal or lighthouse tube, operating conventionally but with very small inter-electrode spacing and a special physical structure that reduces inter-electrode capacitance. Other alternatives have been the Barkhausen-Kurz method, where the grid is highly positive and the plate is slightly negative with respect to the cathode. A more recent development is the Fonda-Freedman electron grouping principle, where conventional tubes are used to generate microwaves by making the transit time from cathode to plate correspond to several even or odd half-periods of oscillation. These will be discussed later, in detail. Various research groups are constantly engaged in the development of more efficient vacuum tube structures to facilitate operations in the microwave region.

NEXT MONTH

Chapter 2 of the MICROWAVE HANDBOOK series will go a little more deeply into the characteristics of frequencies from 300 to 30,000 mc., discussing reactance effects, skin effects, displacement currents, and simulated components.

DIRECTORY OF TELEVISION STATIONS

Showing Stations on the Air, G.P.'s. Granted, and Applications Filed as of Jan. 1, 1948

ACCORDING to information released by the FCC there was, on December 15, a total of 6 licensed television broadcast stations in the United States. In addition, 11 stations were under temporary authority, construction permits had been granted to 54 others, and 72 applications were pending. Of those, 25 were in hearing.

In the accompanying list, the status of each station is indicated in the last column: L indicates license granted; TO indicates temporary operation under special authority; CP indicates construction permit granted; A indicates application filed; and IH indicates that the application is in hearing.

The total list includes 64 cities in 31 states. Following the name of each city is the number of stations assigned to it under the newly proposed allocations plan in which Channel 1 may be eliminated.

ALABAMA			
BIRMINGHAM—3	CH. 4	KW.	A
Birmingham Bcstg Co			
CALIFORNIA			
BAKERSFIELD			
Pearl Lemert	10		A
HOLLYWOOD—see Los Angeles			
KTLA	5	30-15	TO
Television Prod. Inc			
LOS ANGELES—7, including Hollywood			
KECA-TV	7	4.5-2.7	CP
Amer. Bcstg Co			
KFI-TV	9	16.1-17	CP
E. C. Anthony, Inc			
KNBH	4	15-8	CP
NH. Bcstg Co			
KLAC-TV	13	16-16	CP
Dorothy S. Thackrey			
Don Lee Bcstg System	2		IH
OAKLAND—see San Francisco			
KROW, Inc	11		A
RIVERSIDE—1			
KARO	1	1-1	CP
Bcstg Corp of Amer			
SAN DIEGO—4			
Bolboa Bcstg Co	6		A
Jack Gross Bcstg	8		A
SAN FRANCISCO—6			
KGO-TV	7	5.4-2.7	CP
Amer. Bcstg Co			
KWIS	5	23.6-12.6	CP
Assoc. Bcstrs Inc			
KCPR	4		CP
Chronicle Publishing Co			
Don Lee Bcstg System	2		IH
S. H. Patterson	9		A
STOCKTON—1			
KGDM-TV	8	1.9-1.8	CP
E. F. Peffer			
CONNECTICUT			
HARTFORD—2			
Connecticut Bcstg Co	10		IH
New Britain Bcstg Co	8		IH
Travelers Bcstg Service	10		IH
Yankee Network	8		IH
NEW HAVEN—1			
WNHC-TV	6	1.8-9.6	CP
Elm City Bcstg Corp			
WATERBURY—1			
Empire Coil Co	12		IH
Fairfield Bcstg Co	12		IH
Harold Thomas	12		IH
DELAWARE			
WILMINGTON—1			
WDEL-TV	7	1-5	CP
WDEL Inc			
DISTRICT OF COLUMBIA			
WASHINGTON—4			
WOIC	9	30-24.5	CP
Bomberger Bcstg Serv.			
WTTG	5	6.25-2.5	TO
A. B. DuMont Labs. Inc			
WMAL-TV	7	27.7-13.9	TO
Evening Star Bcstg Co			
WNBW	4	20.5-17	TO
NH. Bcstg Co			
FLORIDA			
MIAMI—4			
WTVJ	4	1.6-7.9	CP
Southern R. & T. Equip.			
Miami Bcstg Co	5		A
Isle of Dreams Bcstg	5		A
Fort Industry Co	5		A
GEORGIA			
ATLANTA—4			
Liberty Bcstg Corp	5		A
Atlanta Journal Co	8		A
Constitution Pub Co	2		A
Liberty Bcstg Corp	5		A

ILLINOIS			
CHICAGO—6			
WENR-TV	7	30-15	CP
WBKB	4	1.8-1.8	L
WNBY	5	21.8-21.8	CP
WGNA	9	18.4-9.4	TO
Amer. Bcstg Co			
Balaban & Katz Corp			
NH. Bcstg Co			
WGN, Inc			
Sun & Times Co	13		A
Columbia Bcstg System	11		A
Johnson-Kennedy Radio	2		A
INDIANA			
BLOOMINGTON—1			
WTTV	10	1-1	CP
Sarkes Tarzian			
INDIANAPOLIS—4			
WWHB	3	14.5-7.6	CP
Wm. H. Black Co			
WFBM, Inc	6		A
SOUTH BEND—1			
South Bend Tribune	13		A
IOWA			
AMES—1			
WOI-TV	4	13-10	CP
Iowa State College			
KENTUCKY			
LOUISVILLE—2			
WHAS-TV	9	9.6-7.2	CP
Courier-Journal			
WAVE, Inc	5		A
LOUISIANA			
NEW ORLEANS—5			
WRTV	4	13.6-7.2	CP
Maison Blanche Co			
Stephens Bcstg Co	6		A
Times Picayune	7		A
MARYLAND			
BALTIMORE—3			
WMAR	2	17.1-17.1	TO
A. S. Abell Co			
WBAL-TV	11	32.6-17.2	CP
Hearst Radio, Inc			
WAAM	13	31.7-20	CP
Radio-Telev. of Balt.			
MASSACHUSETTS			
BOSTON—5, including Waltham			
WBZ-TV	4	14.3-7.2	CP
Westinghouse Radio Sta.			
WNAC-TV	7	32.7-32.7	CP
Yankee Network, Inc			
Boston Metro. Tele. Co	9		IH
E. Anthony & Sons Inc	9		A
Columbia Bcstg Sys	9		A
Empire Coil Co	9		IH
Mass. Bcstg Corp	9		IH
Matheson Radio Co	13		A
New England Tele. Co	13		IH
N. E. Theatres, Inc	13		IH
FALL RIVER—see New Bedford			
New England Tele. Co	8		A
NEW BEDFORD—1, including Fall River			
E. Anthony & Sons Inc	1		A
WALTHAM—see Boston			
WRTB	2		CP
Roytheon Mfg Co			
MICHIGAN			
DETROIT—4			
WWJ-TV	4	17.1-17.1	TO
Evening News Assn.			
WTVQ	2	14.3-7.5	CP
Fort Industry Co			
WDLT	7	32.1-16.7	CP
King-Trendle Bcstg Corp			
United Detroit Theatres	5		IH
WJR Inc	5		IH
MINNESOTA			
MINNEAPOLIS—see St. Paul			
WTCN-TV	4	17.9-9.2	CP
Minn. Bcstg Corp			
SAINT PAUL—5, including Minneapolis			
KSTP-TV	5	13.7-6.5	CP
KSTP, Inc			
MISSOURI			
KANSAS CITY—4			
Kansas City Star	4		A
ST. LOUIS—5			
KSD-TV	5	18.2-18.7	TO
Pulitzer Pub. Co			
NEW JERSEY			
NEWARK—see New York			
WATV	13	17-8.3	CP
Bremer Bcstg Corp			
TRENTON	1		A
Trent Bcstg Corp			
NEW MEXICO			
ALBUQUERQUE			
KOB-TV	4	4.5-4.5	CP
Albuquerque Bcstg Co			
NEW YORK			
BUFFALO—4			
WBEN-TV	4	15-8	CP
WBEN, Inc			
Courier Express	7		A
NEW YORK—7, including N. E. New Jersey			
WJZ-TV	7	16.3-8.3	CP
Amer. Bcstg Co			
WOR-TV	9	16.3-8.3	CP
Bomberger Bcstg Serv.			
WCBS-TV	2	1.7-1.7	L
Columbia Bcstg System			
WABD	5	14.3-9.5	L
NH. Bcstg Co	4	7-5.8	L
WNBT			
NIAGARA FALLS—See Buffalo			
Empire Coil Co	13		A

ROCHESTER—3			
Stramberg-Carlson Co	6		A
SCHENECTADY—5, including Albany and Troy			
WRGB	4	40-21.3	L
General Electric Co			
NORTH CAROLINA			
CHARLOTTE—3			
Jefferson Standard Bcstg	3		A
OHIO			
AKRON—1			
A. T. Simmons	11		A
CINCINNATI—4			
WLWT	4	23.9-19.5	CP
Crosley Bcstg Corp			
A. B. DuMont Labs.	2		IH
Cincinnati Times-Star	11		A
CLEVELAND—4			
WXEL	9	21-13	CP
Empire Coil Co			
WNBK	4	18.8-9.6	CP
NH. Bcstg Co			
WEWS	5	18.2-9.1	TO
Scripps-Howard Radio, Inc			
A. B. DuMont Labs.	2		IH
WGAR	7		IH
United Bcstg Co	7		IH
WWJ, Inc	2		A
COLUMBUS—3			
WLWL	3	15.5-5.3	CP
Crosley Bcstg Corp			
DAYTON—2			
WLWD	5	30-25	CP
Crosley Bcstg Corp			
Miami Valley Bcstg	13		A
TOLEDO—1			
WTVT	13	27.4-14.4	CP
Fort Industry Co			
OREGON			
PORTLAND—5			
KGWG	6	10-11.2	CP
Oregonian Pub. Co			
PENNSYLVANIA			
ALLENTOWN—1, Includes Allentown, Bethlehem			
Lehigh Valley Bcstg	8		A
ERIE—1			
Dispatch Inc	12		A
HARRISBURG—1			
Harold O. Bishop	8		IH
WHP, Inc	8		IH
JOHNSTOWN—1			
WJAC-TV	13	6.5-7	CP
WJAC, Inc			
LANCASTER—1			
WGAL Inc	4		A
PHILADELPHIA—4			
WPEN-TV	10	25-26.5	CP
Wm. Penn Bcstg Co			
WFIL-TV	6	18.1-9.3	TO
Philadelphia Inquirer			
WPTZ	3	2.7-2.8	L
Philo Telev Bcstg Corp			
Daily News Telev Co	12		IH
Penn. Bcstg Co	12		IH
PITTSBURGH—4			
WDVT	3	14.6-7.3	CP
A. B. DuMont Labs.			
Allegheny Bcstg Corp	8		A
Empire Coil Co	10		A
WPT, Inc	10		A
WWSW, Inc	10		A
Westinghouse Radio Sta	6		A
WILKES-BARRE—2, including Scranton			
Louis G. Baltimore	11		A
Wyoming Valley Bcstg	11		A
RHODE ISLAND			
PROVIDENCE—1			
WJAR-TV	11	50-50	CP
The Outlet Co			
Cherry & Webb Bcstg	13		A
TENNESSEE			
MEMPHIS—5			
Bluff City Bcstg Co	5		A
Memphis Pub. Co	4	13.6-7.1	CP
TEXAS			
DALLAS—3			
KRLD-TV	4		CP
KBTB	8	35-18.5	CP
KRLD Radio Corp			
Lacy-Potter Telev Bcstg	3		IH
Interstate Circuits, Inc	10		A
Texos Television	10		A
A. H. Belo	10		A
FORT WORTH—3			
KCPN	5	17.6-8.2	CP
CARTER Publications, Inc			
HOUSTON—4			
W. Albert Lee	2		A
UTAH			
SALT LAKE CITY—5			
KDYL-TV	2	13.2-7	CP
Intermountain Bcstg Corp			
VIRGINIA			
RICHMOND—4			
WTVR	6	12.2-6.4	CP
Havens & Mortin, Inc			
WASHINGTON			
SEATTLE—4			
KRSC-TV	6	18.9-9.8	CP
Radio Sales Corp			
WISCONSIN			
MILWAUKEE—4			
WTMJ-TV	3	16.1-17	TO
The Journal Co			

DISCUSSION OF FM PROPAGATION TESTS

Text of a Supplementary Brief Concerning Norton-Allen Testimony before the FCC

BY MAJOR EDWIN H. ARMSTRONG*

THIS supplemental brief, like the brief dated October 7, 1947,¹ and filed by me in this proceeding, is directed to the question specified in the Commission's Order of September 19, 1947, viz., as to which category of radio service should be assigned the band of frequencies from 44 to 50 mc.

The specific purpose of this brief is to reply to certain testimony presented at the hearing by Edward W. Allen, Jr., Chief of the Technical Information Section of the Commission, and Kenneth A. Norton, formerly employed in the same Section of the Commission.

This brief is concerned with an observed and now well-demonstrated physical fact, namely, that at distances beyond the horizon a phenomenon known as fading appears, which affects the frequencies around 100 mc. much more seriously than it affects the frequencies around 50 mc.

As a result of that physical fact, various stations on the Continental Network at distances above 75 miles from Alpine, are unable to receive the 92.1 mc. transmissions from Alpine with sufficient reliability to rebroadcast them, but do receive the Alpine signals on the 44.1-mc. channel with sufficient reliability and do rebroadcast them. Station WBCA at Schenectady is an example. It is located some 120 miles from Alpine and has been rebroadcasting the low band programs from Alpine for upwards of 5 years.

The same physical fact was observed by me as early as 1938, when I had experimental transmitters operating on the 117-mc. band and on the 42-mc. band, and my observations were reported to the Commission at the allocation hearings in 1944 and 1945.

For the purpose of getting an accurate comparison of the effects of fadings on the two bands, I have been conducting tests at Westhampton Beach since July, 1947, making recordings of the two Alpine signals, one on 92.1 mc. and the other on 44.1 mc. Each of the stations has approximately 100 kw. power, which is enough to permit highly accurate measurements to be made. The two antennas are located on the same tower and are of the same height, so that the signals travel over the same path. Westhampton Beach is 70 miles from the Alpine station, and the conditions of reception there are ideal for checking the accuracy of the-

oretical predictions, since there is a clear path across Moriches Bay, no hills of any consequence between the transmitter and receiver, and little or no local interference. Specially designed crystal-controlled receivers are used, and the recorder armatures are driven directly by current obtained from crystal rectifiers. I do not believe that the accuracy and reliability of the apparatus used in the Westhampton Beach tests will be questioned by anyone.

All the recordings taken during the period from September 7 to November 3, 1947, were presented to the Commission at the hearing. They show that for approximately 50% of the days in that period the signals on 92.1 mc. suffered severely from fading, whereas the 44.1-mc. signals were not substantially affected by fading.

Mr. Allen's Curves ★ Against this background of observation and tests, Mr. Allen has prepared 6 charts designed to show that the physical fact so observed and demonstrated does not actually exist. At the hearing, Mr. Allen presented a report dated November 18, 1947, entitled "Preliminary Report on East Coast Tropospheric and Sporadic E Field Intensity Measurements on 47.1 and 106.5 Mc." (Exhibit 52). The charts, which are contained in the report, are designed to show the relative performance of low and high band signals (47.1 mc. and 106.5 mc.) at distances of 45, 68 and 185 miles from the transmitters — the important distance, for present purposes, being the intermediate distance of 68 miles.

These charts present graphically Mr. Allen's conclusions, which are directly opposite to the conclusions arrived at in the Westhampton Beach tests and corroborated by other observations made at many points. Specifically, they purport to show that at Southampton, Pa., where signals on 47.1 mc. and 106 mc. were received from 2 stations located in New York on top of the same building, at a distance 68 miles, the transmission on 106 mc. was very much better than on 47.1 mc.; that, in fact, the field strength which was exceeded for 99% of the time on the high band was $3\frac{1}{2}$ times the field strength so exceeded on the low band.

The shortest and perhaps the most satisfactory answer to a series of curves purporting to demonstrate that an observed physical fact does not exist is the answer that would be given to a similar demonstration that the earth was flat.

By whatever means the conclusions may have been arrived at, and whatever errors may have been involved, the inescapable fact is that the conclusion is wrong.

Mr. Allen did not present to the Commission the underlying recordings on which his analysis was based, but those I have now examined pursuant to permission given to me at the hearing (Tr. 774), and it is my conclusion that there were fundamental errors in both the tests made and the methods of analysis that Mr. Allen applied to them.

Failure to Measure Transmitter Power ★ Mr. Allen was comparing stations with widely different amounts of power — the 47.1-mc. transmitter having an assumed power of 10 kw. and the 106.5-mc. transmitter an assumed power of 725 watts.² It was necessary for him, therefore, to convert his results into a common denominator, i.e., field strength per kilowatt. His comparison would necessarily be affected by any variation of the radiated transmitter power from the assumed power. Hence the first requirement in any such test is to get an accurate check on the radiated power of each transmitter by making field strength measurements at a suitable location within line of sight. That Mr. Allen failed to do; and for this reason alone his results are unreliable.

The first explanation that would occur to anyone who inquired why the Commission's tests showed results so widely different from the practical experience of broadcasters and listeners is that the effective transmitter power on the low band was nothing like the 10 kw. that Mr. Allen assumed it was; and that conclusion is strongly supported by Fig. 5 of the Allen Report (Exhibit 52), which compares actual and theoretical field intensities at the various points of reception. There it is shown that at Princeton, 45 miles from the transmitter, the highband signal was approximately equal to the theoretical field strength (as per the Norton Curves), while for the low band signal there was a wide discrepancy — an actual figure of only 22 for the median field as compared with a theoretical figure of 56.

In other words, the actual field intensities of the low band station, measured at Princeton, fell 60% short of those called for by the Norton Curves.

² From October 10, to the end of the Southampton tests on November 20, the transmitter was equipped with a radar antenna, and for that period it may be assumed that the effective power was above 50 kw. (Exh. 52, p. 1 of Preliminary Report).

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¹ Text of the original brief was published in *FM and TELEVISION*, Nov. 1947.

In all the controversy about the Norton Curves, no one has disputed that they are fairly reliable for distances up to 40 or 50 miles over smooth earth. A discrepancy of 60% at Princeton, therefore, should have alerted Mr. Allen to the fact that something was radically wrong³; and the first thing that should have occurred to him was that he should check the effective transmitter power on the low band. But that he did not do; and in his report (on p. 5) he calmly disposes of the 60% discrepancy in his observations by the simple statement that: "It is observed in Fig. 5 that the median field on 106.5 mc. at Princeton is nearly equal to the theoretical field, while the 47.1-mc. field is below [*sic*] the theoretical field at this distance." If Mr. Allen had said "60% below," it would have been disclosed on the face of the report that the low band station was giving him only 40% of the performance that so firm a believer in the Norton Curves should have expected.

At the hearing (Tr. 766-67) Mr. Allen reaffirmed his earlier statement that: "I know of no case where, when all the factors are taken into account, you cannot reconcile your measured result with what is predicted by using Mr. Norton's theoretical calculated methods of estimating distance ranges." The difficulty in this particular instance was not only that Mr. Allen did not take "all the factors . . . into account," but that he failed to verify the most important factor of all, namely, the power of the transmitters.

He did make inquiry 2 months after the Southampton tests had been discontinued, as shown by a letter of January 15, 1947, from Slowie to Poppole. That letter, which makes clear that up to that time the Commission had very little information—even from the station which was doing the broadcasting—as to the power or probable power or either transmitter, reads in part:

"The Commission's records indicate that station WBAM has been operating with a power of 10 kw. on 47.1 mc., and with either 0.8 or 1.0 kw. power on 106.5 mc. It is not clear whether these values of power represent estimates of radiated power, or whether the values include losses in the transmission lines.

"Any information you are able to fur-

nish regarding the following items will be helpful in the analysis of recorder charts made at Southampton and Laurel:

"(1) Effective radiated power on 47.1 mc.

"(2) Effective radiated power on 106.5 mc.

"(3) If 106.5 mc. transmitted power was increased, date change was made.

"(4) Estimated or measured gain of radar antenna installation over the horizontal dipole previously used."

Poppole's answer gave various figures (including the manufacturer's estimate of transmitter efficiency as 60%) which, if correct,⁴ would result in a computation of transmitter power for the low band at about 10 kw. For the high band transmitter, however, during the period when it had a radar antenna, the reply admitted that "unfortunately" no proper determination of the radiated power of the transmitter had been made.

Since there is no way at this late date of checking what the transmitter power was at various times during the test, and therefore no way of determining how much of an error entered into the underlying recordings, those recordings cannot serve any useful purpose.

Use of Two Methods of Analysis ★ The recordings taken at Southampton, Pa., were analyzed by Mr. Allen by two different methods, explained in his report at page 5. (a) "by determining the number of minutes in each hour during which the various levels of field intensity were exceeded," and (b) "by taking hourly median values," *i.e.*, by determining for each hour the field intensity that was exceeded during 50% of the hour.

The instantaneous or minute-by-minute method of analysis, if properly used, gives a good representation of the effects of fading. It shows the percentage of the time during which the signal intensity exceeded various levels—some high point, some intermediate points, and some low points. It therefore shows where the signal intensity dropped off to levels at which service would be unsatisfactory.

The hourly median value, however, has no significance in an analysis designed to show the effects of fading. All that it presents is a kind of average of the high and low points. It does not help the radio listener, if over an hour, the signal becomes inaudible 15 or 20 times, to be told that the *hourly median* was well above the level required for good reception. The peak signals offset the drop-outs on Mr. Allen's charts, but cannot offset them in the radio set or in the ears of the listener. The drop-outs are there and the signal is no good. Thus, in a study intended to present the effects of fading, the hourly median is an absurdity. It is as if one who

is asked to determine the number of days of freezing in a year should present his observations in the form of a graph showing average monthly temperatures. In either case the low points—which are the significant facts to be brought out—are concealed.

This point was made during the cross-examination of Mr. Allen, when I showed him a recording made at Westhampton Beach on October 4, when there was a considerable variation in signal strength on the high band and the signal dropped to a small fraction of its value at frequent intervals. I pointed out to Mr. Allen that from the standpoint of the radio listener the signal represented on the chart was a bad signal; but that on the basis of the hourly median value it was an excellent signal, since for 50% of the time the strength of the signal was well above that required for good reception. Mr. Allen agreed with me, and his admission completely refutes the statement in his report, page 5, that "Comparisons were made in several instances with distribution curves for instantaneous values, and the difference between the two types of curves are not significant."⁵

Of course, when the signal is not fluctuating widely the analysis by hourly median values and the analysis by minute-by-minute values may give the same or similar results; and doubtless, there were many "instances" during the tests where that was the case. But those are not the "instances" that are significant to the problem at hand. The significant instances are those where the two methods of analysis *do not* give the same result—the days when the signal is fluctuating widely and there are many drop-outs. On those days, the median value between the highest and lowest signal strengths is of no importance whatever.

Application of the Two Methods ★ The minute-by-minute method of analysis, then, discloses the presence of drop-outs caused by fading, while the hourly median method averages out the fades with the peaks and conceals the presence of the drop-outs. The latter method, therefore, should not have been used at all in Mr. Allen's analysis. It was not used in his studies of the recordings made at the other 3 points of reception—Princeton, N. J., Laurel, Md., and Powder Springs, Ga. It is difficult to understand why it was used in analyzing the Southampton recordings.

But worse than the mere use of the method was the manner in which it was used, so as to distort the comparison between the two bands.

The concluding text of the Armstrong brief will be published next month.

³ A prior report of simultaneous field strength recordings on 46.7, 83.75 and 107 mc., made in 1945 by Carlson of RCA Laboratories and furnished to the Commission, had showed a close correlation between the measured normal and theoretical field strengths on 46.7 and 83.75 mc. at Princeton for transmissions received from New York City stations 45 miles distant. RCA Laboratories Technical Report PTR-31, November 9, 1945. Carlson, who also made the recordings at Princeton for the Commission on 47.1 and 106.5 mc., realized that something was wrong and wrote the Commission on August 15, 1946, as follows: ". . . We are somewhat concerned about the accuracy of our field strength measurements here at Princeton. Does Mr. E. W. Allen intend to make a field strength measurement on 700 mc. at Princeton as was planned last spring? If this is to be done it would also be desirable to bring along equipment for measuring the field strength on 47.1 and 106.5 mc."

⁴ The Technical Information Section neither had then nor has now any information by which it could determine whether the figures were correct.

⁵ Allen's testimony indicates that the comparisons were not made anywhere except at Princeton (Tr. 763). The distance from the transmitter to Princeton being only 45 miles, a wide difference between the two types of curves would not be expected at that point.

SPOT NEWS NOTES

Items and comments, personal and otherwise, about manufacturing, broadcasting, communications, and television activities

Wayne Coy: Appointed FCC Chairman by President Truman on December 26. Chairman Coy was born on November 23, 1903, in Shelby County, Ind. Following an early newspaper career, he held several important Government posts from 1933 to 1944. Since then, he has operated the *Washington Post's* local independent station WINX. Thus, he is the first experienced broadcaster appointed to the FCC. As of January 1, the Commissioners are: Democrats, Chairman Coy, Indiana; Walker, Oklahoma; and Durr, Alabama; Republicans, Hyde, Idaho; Jones, Ohio; and Sterling of Maine; Independent, Webster, D. C. Chairman Coy's term will end June 30, 1951.

George E. Sterling: Appointed by President Truman on December 26 to fill the vacancy resulting from the resignation of FCC Commissioner Jett. Commissioner Sterling, born in Maine in 1894, has been in government service since 1923. After his appointment as Chief of the National Defense Operations Section of the FCC Field Division, he rose rapidly to his present post. Previously, he was FCC Chief Engineer, succeeding George P. Adair, who resigned last May. His term expires June 30, 1950.

E. K. Jett: After 37 years in Government radio service, resigned his commissioner-ship in the FCC as of December 31, to become vice president and director of radio for *Baltimore Sunpapers*. He will head the operation of WMAR-TV, and FM and AM stations for which grants have been issued. In accepting Commissioner Jett's resignation, President Truman commended him highly for his past work, concluding: "You carry with you, as you return to private life, my best wishes for your success."

Looking Ahead: Many strange decisions and puzzling actions have come from the FCC. In retrospect, the record shows a net balance of constructive service, but it carries many red ink entries of decisions and conduct by its members that do not represent the service of public interest, convenience, and necessity. We are sorry to see Mr. Jett leave the Commission. Even when we disagreed with his opinions, we never questioned his sincerity and his practical point of view. We are not as well acquainted with Chairman Coy, but we are glad to see a business executive in the Chairman's post, rather than an out-and-out lawyer such as Mr. Fly, or a political opportunist such as Mr. Porter. As for Commissioner Sterling, we welcome him as a fellow New Englander who, we believe, will prove an able successor to Mr. Jett.

WBEN-TV: Buffalo station expects to start regular television broadcasting on April 1st. J. Woodrow Magnuson will be in charge as television supervisor. Studios are under construction at Hotel Statler.

Facsimile Installation: First G.E.-built Hogan facsimile equipment is being installed by the *Miami Herald*. Regular facsimile schedule will be transmitted over WQAM-FM. (See FM & TV, Apr. 1947 for details of initial tests.)

Lancaster, Pa.: RCA will spend over \$1,000,000 to build and equip a 40,000-sq. ft. addition to their Lancaster tube factory, where 1,600 are now employed. New building will be devoted to cathode-ray tube production.

WGHF: Finch station in New York City is off the air temporarily while new equipment is being installed to bring the station up to authorized power. Full schedule will be resumed early in January. This station has been doing an excellent job of live-talent broadcasting, with notable dramatic presentations and well-balanced musical programs.

TBA Officers: J. R. Popple has been re-elected president of Television Broadcasters Association, and John F. Royal was elected vice president. Also reelected were secretary-treasurer Will Baltin, assistant secretary-treasurer Paul Ralibourn, and directors Dr. Allen B. Dumont, Curtis W. Mason, and F. J. Bingley.

Requiem: *Frequency Modulation Business* has ceased publication, and the company has been liquidated. We are sorry to hear of the passing of this magazine only 18 months after it started. The publishers' practice of shortening the name to FM *Journal* caused much confusion with FM AND TELEVISION which, when it was established in 1940, was called FM MAGAZINE. At least we are glad to have that confusion ended because many readers and even our own staff still call this publication FM Magazine.

New Address: Antenna & Tower Equipment Company, handling the erection of Win-charger towers and Andrews antenna equipment, has moved from Albany, N. Y., to 500 Cove Road, Stamford, Conn.

Audio Quality on FM: We've heard it said that, as soon as several FM stations get on the air in any area, those with inferior audio equipment are not going to hold listeners. There's no question about that. Now that we can hear 10 to 12 FM stations at Great Barrington, we've weeded

out those whose audio quality is sub-standard, and we just skip past them on the dial!

Rehearing: FCC's decision on New York City FM grants has been set aside because two Commissioners who voted were not sitting at the oral argument. No reference was made to then-Chairman Denny's preparations, at that time, to join NBC. So the largest city in the U.S.A. is still without its quota of FM service. And another mark is chalked up against the Commission for prejudging a situation on the basis of star-chamber idiology, rather than on the facts of the case.

Max F. Balcom: RMA president, discussing 1948 set production: "The outlook for the radio industry is most encouraging. Television and FM broadcasting are injecting new blood into the industry."

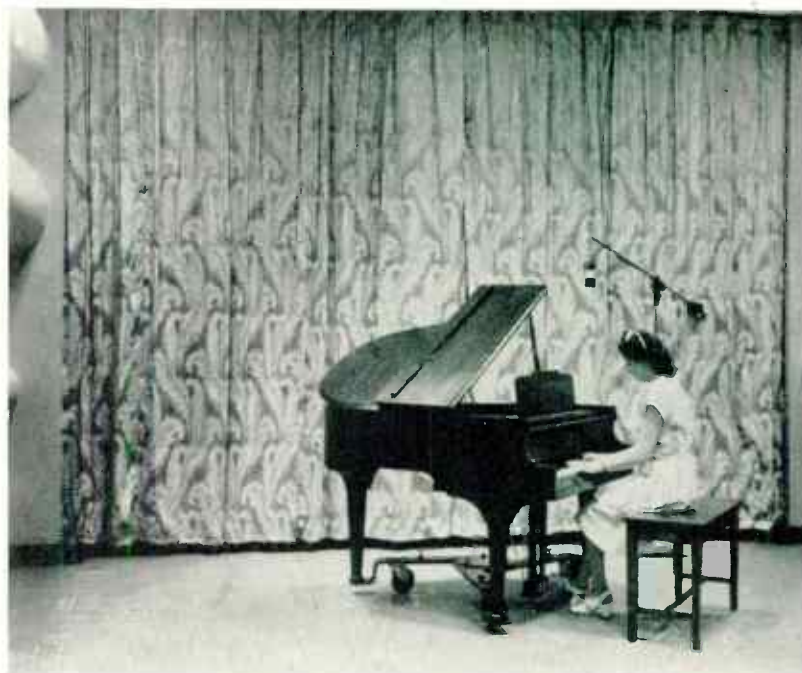
Rochester: Stromberg-Carlson plans for erecting a television station are temporarily stymied by opposition of residents in the Pinnacle Hill section which, unfortunately, is the ideal location for a TV antenna. S-C will now undertake persuasion, building their campaign around a report being prepared for the City administration by an expert from University of Rochester.

H. William Koster: Former program director at APRO Providence, and manager of WAAB Worcester, has been engaged as manager of the new FM station WPJB, under construction by the Providence (R. I.) Journal Bulletin. WPJB will have 20kw. on 105.1 mc.

FM Station Score: There are now 376 FM broadcast stations on the air, 634 construction permits and conditional grants issued, and 117 applications pending; total 1,127.

Research Center: First building of Sylvania's research center will be started early next spring at Bayside, Long Island. Contract has been let for 2-story brick structure of 38,000 sq. ft. Campus-type project will eventually cover 28 acres of 57-acre plot facing the Sound, and 5 laboratories now occupying temporary quarters will be moved to this location. The first building, to house Sylvania's physics laboratory, will cost nearly \$1,000,000 when fully equipped.

Bernard G. Peter: Assistant State's Attorney for Baltimore has resigned to become manager of WMCP, the first exclusively FM station in Baltimore, Md. WMCP will go on the air in February with 20kw. at 94.7 mc.



1: SPECTRORADIOMETER TESTS LUMINOUS MATERIALS FOR CATHODE-RAY TUBES 2: GLASS CURTAIN ADJUSTS STUDIO ACOUSTICS

NEWS PICTURES

1. The Spectroradiometer shown here is a new instrument used at RCA's Lancaster plant to analyze test samples of luminescent materials for coating cathode-ray tube screens. Operating the instrument is Austin E. Hardy, head of the physical testing laboratory, and designer of the Spectroradiometer.

2. At FM station WCLT Newark, Ohio, the main studio is equipped with an adjustable acoustic curtain, by means of which the acoustical dimensions of the

room can be controlled to suit the number and type of musical instruments and the number of people taking part in any program. The curtain is woven of non-combustible Fiber glass yarn, backed by an absorbing blanket of extremely fine glass fibres.

3. Dr. Frank G. Back, right, of Jerry Fairbanks Productions, received the TBA's highest award on December 10, in recognition for his work in developing the Zoomar lens for television cameras. Paul Raibourn made the presentation.

4. National Bureau of Standards has set up two of these giant radar mirrors to

observe and analyze radio noise generated by the sun. The plan is to correlate solar noise with other solar, interstellar, and terrestrial phenomena. Radar reflectors will follow the sun continuously.

5. F. M. Flynn, seated, president and general manager of the *New York Daily News*, plans to have W1TV on the air late this spring. Original plan was to install FM and television equipment at the same time. Now, with their FM application still in hearing, the *News* will go ahead with the TV permit already granted. Standing, right, is Cliff Denton, chief engineer in charge of all *News* radio facilities, and Howard Mandernach.

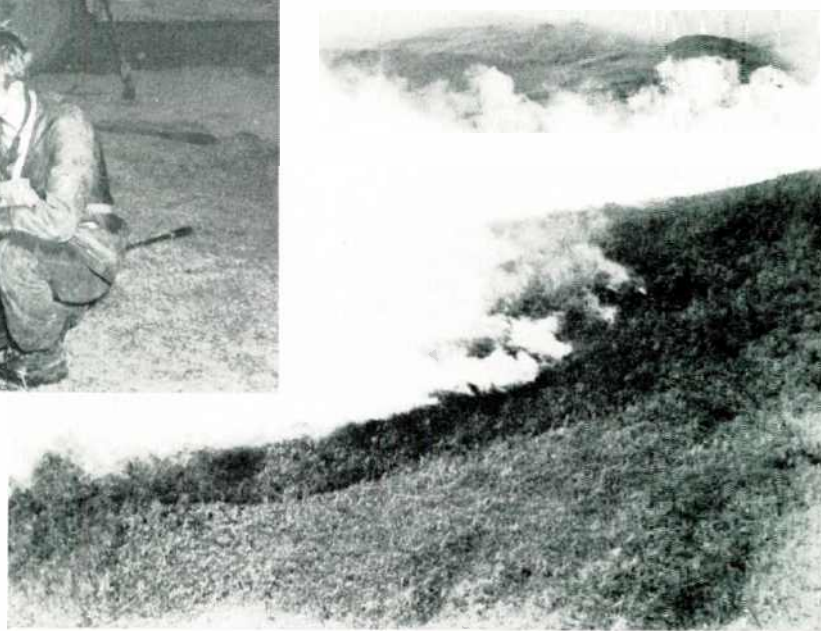
3: TBA AWARD TO DR. FRANK BACK. 4: M.B.S. INVESTIGATES SOLAR RADIO NOISE 5: F.M. FLYNN AND CLIFF DENTON PLAN FOR TV





ABOVE: MUCH OF THE FIRE-FIGHTING WAS DONE BY MEN EQUIPPED WITH GAS MASKS AND WATER TANKS CARRIED ON THEIR BACKS. GASOLINE AND OIL TRUCKS, DISPATCHED BY RADIO, SUPPLIED THE WATER

BELOW: THE WIND SPREAD THE FIRES UNTIL WE WERE FIGHTING ALONG LINES MANY MILES WIDE. TYPICAL CONDITIONS ARE SHOWN IN THIS AIRPLANE VIEW OF THE MT. SUNAPEE AREA



HOW FM FOUGHT FOREST FIRES

Report on Experiences During Forest Fires in New Hampshire

BY LIEUT. BASIL CUTTING*

THE series of forest fires that broke out during the extremely dry period last October, burning thousands of acres in New Hampshire, Maine, and Massachusetts, gave us our first experience in handling large area conflagrations with the aid of radio communications.

This was not a matter of fighting one big fire, but a great number of separate fires, all starting at about the same time. Fortunately, the New Hampshire State Police has a well-organized communications system,¹ closely coordinated with the municipal police and the Fish and Game Department. Thus our State Police headquarters at Concord was prepared to act as a central point for clearing all fire message traffic. In addition, we supplied the broadcast stations with information on the locations and spread of the fires, to serve as warnings to the public.

As soon as the situation developed to emergency proportions, the Yankee Network station WKXL, Concord, furnished a 4-place plane in which we quickly installed a modified cruiser transmitter, so that we could fly over the fire areas, appraise the conditions accurately and give

a prompt report. That was on Wednesday, October 22. Norm Bailey of WKXL handled the microphone. Keith Rand was pilot, and the writer directed the flight operation. On the ground, WKXL chief engineer Norman Partridge and Trooper Bellerose set up a Brush recorder so that a transcription of our report could be broadcast.

In a period of 2 hours, we spotted 14 separate forest fires. At 65 miles, where we were farthest from State Police headquarters, our mobile transmitter on 37.38 mc. still delivered ample signals for recording. The transcriptions were broadcast over WKXL, and repeated later over all Yankee Network AM and FM stations.

Meanwhile, our observations from the air supplied information for setting up fire-fighting activities on the ground. As the situation grew worse, Governor Dale was notified. He immediately closed all woodland to hunters and campers.

By the end of the afternoon, traffic to cruiser cars and municipal police departments increased to an average of a message a minute. We dispatched cars from the State Police and Fish and Game Department to critical points where they could maintain contact with the forest fire wardens.

In New Hampshire, Fish and Game Department cars use the State Police fre-

quencies (AM out and FM back) and operate with our main station WRPT. This emergency certainly proved the wisdom of having both law enforcement agencies coordinated in one radio system.

On Thursday, the 23rd, the wind increased to a velocity of 25 to 35 miles per hour, and the fires were spreading rapidly. All cruisers not in fire areas were put on 24-hour duty. Messages were coming in fast and furiously from all parts of the State, over distances up to 70 miles. Considering that a range of mountains runs the length of New Hampshire this was a real test of our FM talk-back system. Privately, the writer congratulated himself for the efficiency of our maintenance work on the mobile units, for cars at fixed points had no periods of cruising to recharge their batteries!

Fire outside Rochester threatened that town on Friday. In the meantime, 150 oil and gasoline trucks in the State had been mobilized for water-carrying service. By radio, we contacted 65 of these trucks, and rushed them into the Rochester area with a police escort. They supplied water to portable pumpers where hose could not be run from water holes or hydrants.

Perhaps the best way to give a picture of the services performed by our radio system is to quote some of the messages:

No. 26 to WRPT: send us 3 more tankers fast.

No. 20 to WRPT: 2,000 ft. of hose needed at East Rochester.

No. 25 to WRPT: want all the men you can send to Farmington.

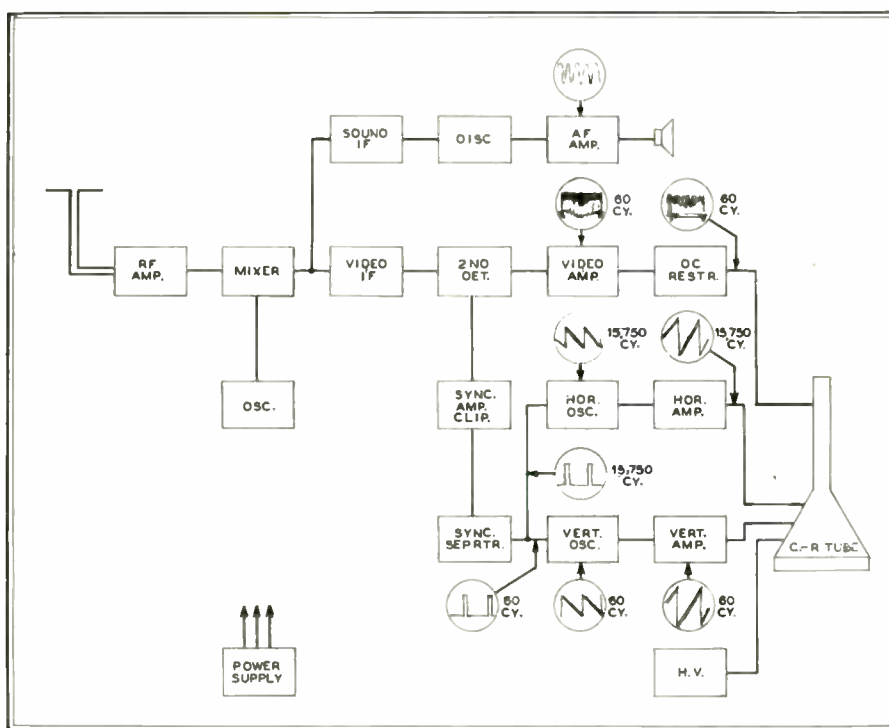
No. 207 to WRPT: more portable pumpers needed at the Tom More farm.

No. 54 to WRPT: move 2 more bulldozers this way on route No. 25.

(CONCLUDED ON PAGE 34)

*Chief Radio Engineer, Department of State Police, Concord, N. H.

¹ See "N. H. State Police System" by Lieut. Basil Cutting, *FM AND TELEVISION*, Jan. 1945 and "Dual Diversity Transmission on 75 Mc." by Lieut. Basil Cutting, *FM AND TELEVISION*, Feb. 1947.



BLOCK DIAGRAM OF A TYPICAL SET SHOWING THE NORMAL PATTERNS AT VARIOUS POINTS

FASTER TV TROUBLE-SHOOTING

How the Oscilloscope Speeds the Work of Locating Trouble

BY WALTER H. BUCHSBAUM*

NOW that television receivers are being sold in appreciable quantities, radio service men must meet a new challenge to their skill and knowledge of trouble-shooting. This calls for meeting a host of new problems. The time honored service methods, such as signal tracing or signal injection, have only very limited applications in the television field.

The first requirement is a knowledge of the basic functions of the various circuits in a television receiver. But once this is learned, a definite and sure method of procedure is necessary.

Old Methods Inadequate ★ Checking tubes is not such a good approach because of the time it takes to check the 20 to 30 tubes of a modern television set. Voltage measurements are always useful, but once it is established that all DC voltages are correct, the usefulness of this is also exhausted.

Signal tracing, of course, is a very positive and certain method, but for television we have to modify it a little, since a loudspeaker cannot give us a clear picture of the complex television signal. That is why the oscilloscope is such a well suited

instrument for television work. It permits us to observe the actual waveform, see exactly what goes on the grid of a certain tube, and then what appears on the plate. It is the most practical test instrument for checking all circuits containing non-sinusoidal waves and signals of different shapes and frequencies.

Oscilloscope Is a Visual Aide ★ The ideal oscilloscope for television work would have a vertical input amplifier with a response flat to 4 mc., a Z-axis, and a screen large enough to observe large and very small waves at the same setting of the vertical gain control. For service work, however, this is not at all necessary, and almost any 'scope with a sweep frequency up to 15 kc. and a vertical input amplifier flat to 100 kc. will do. A third or Z axis is nice to have, but not essential. Many servicemen already have 'scopes which they used occasionally for their radio work, and most of these will also be usable for television trouble-shooting. It is very important to be thoroughly familiar with the 'scope, and to know all its possibilities.

Measuring Peak Voltage ★ For instance, do you know an easy way of measuring peak voltages with the oscilloscope? Well, here

it is. Put your vertical input lead on a 6.3-volt AC filament source, such as is used in all television sets. You will see a 60-cycle sine wave on the tube. Next, adjust your horizontal gain control to have only a vertical line on the screen. If you have a raster over the face of the 'scope, adjust your vertical gain so that the line covers 18 small vertical squares. If you have no raster, mark the face of the cathode ray tube with a grease pencil approximately. You are now measuring a peak voltage of 18 volts. We know that 6.3 volts RMS gives roughly 18 volts peak-to-peak, and if you now want to measure the peak voltage of any kind of signal, just put your vertical 'scope lead on the point in question and count the number of squares covered vertically. The number of squares will correspond exactly to the number of peak volts of the signal in question. Once the raster is calibrated, all sorts of voltage waves can be measured as long as the vertical gain control is not moved. Many oscilloscopes have a vertical range control, usually marked $\times 100$, $\times 10$, $\times 1$. By making the calibration with the range set at $\times 1$, it is possible to read accurately not only from 0 to 18 volts or so, but up to 1,800 volts, depending on the setting of the range control, if the vertical gain control is not disturbed.

Checking Frequency ★ Another good use for the 'scope is to check frequencies. If, for instance, you are trying to determine whether the horizontal sweep control in the television set really changes the sweep frequencies over a sufficiently wide range, set the sweep frequency of the 'scope to approximately 15,750 cycles, put the vertical input lead on a point in the television set where you can get the horizontal sawtooth signal, as in Fig. 1, and try to get it to stand still on the screen by working the horizontal hold control in the television set. Then change the setting of the frequency on the 'scope a little, and try to synchronize the frequencies.

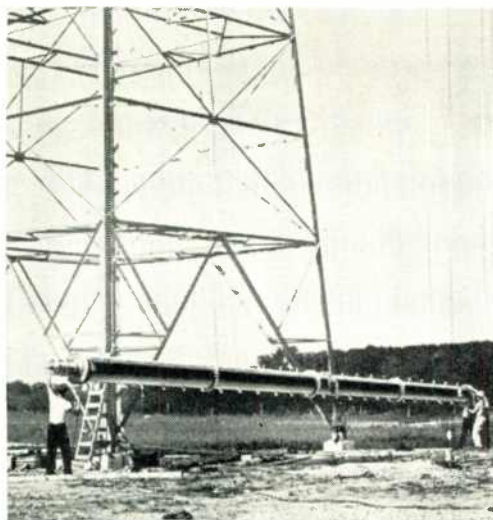
This will give you a rough check whether the horizontal hold control of the set is functioning properly. For an exact check, an audio signal generator is required, and the principle of Lissajon's figures used.

Probe and Lead ★ Most oscilloscopes come with a probe of some sort, usually one containing a series resistor and condenser. If this probe is not available, it is easy to make one up. For most purposes, it is sufficient to connect a .1-mfd. condenser and a 1-megohm resistor in series with the vertical output lead, and cover this combination with tape. The condenser is just a blocking condenser to keep DC off the grid of the amplifier tube, in case no blocking condenser is provided internally. The 1-megohm resistor serves to limit any surges, and also minimizes the loading effect of the 'scope.

* Engineering Department, Garod Radio Corp., 70 Washington St., Brooklyn 1, N. Y.



Assembling the sections into one unit



Ready to hoist



Going up

Up she goes... as

RCA's super-gain antenna—

VIRTUALLY NOTHING TO IT . . . putting up a Pylon. Because the standard Pylon weighs so little . . . is completely self-supporting . . . is erected as a single unit, whether you choose one section or four.

Plenty of other installation features, too.

You assemble this antenna and make all inter-connections *on the ground*. And "in the air" you make only one connection—this to the transmission line. Compare transmission line simplicity like that with the multiplicity of connections required by ordinary antennas.

No adjusting or tuning is required, either, in the field or at the factory.

Here is the FM radiator that can be safely mounted . . . almost anywhere. No protruding elements to brace. No appendages of any kind to fall. Icing problems, negligible . . . because transmission lines are *inside* the polyethylene-covered slot of the antenna cylinder.

Overlook none of the advantages of the Pylon when you choose the radiator for your FM station. It is simpler in design, easier to install . . . gives you more signal gain.

"Photos, courtesy of WJPG-FM, Green Bay, Wis."

There's an RCA Pylon for Every FM Broadcast Station Need

STANDARD PYLON. This antenna is designed to meet the requirements of all FM stations . . . handles up to 50 KW of power. The Standard combines maximum strength and rigidity with minimum weight.

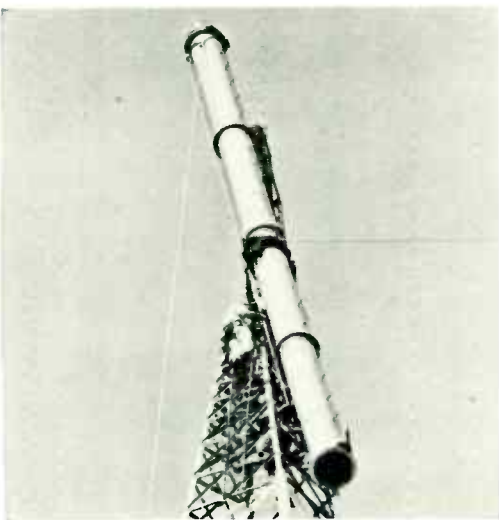
HEAVY-DUTY PYLON. Designed for use with the RCA Television Super Turnstile, this is the only FM antenna capable of supporting a television antenna. The Heavy-Duty Pylon is built for locations where winds of hurricane force prevail. It is designed to withstand wind velocities of more than 160 mph when used for FM service alone.

LOW-POWER PYLON. Here is the ideal low-cost antenna for interim operation and stand-by service. It has the same high gain as the other two models but is available only as a single-section antenna. It handles up to 3 KW of power.

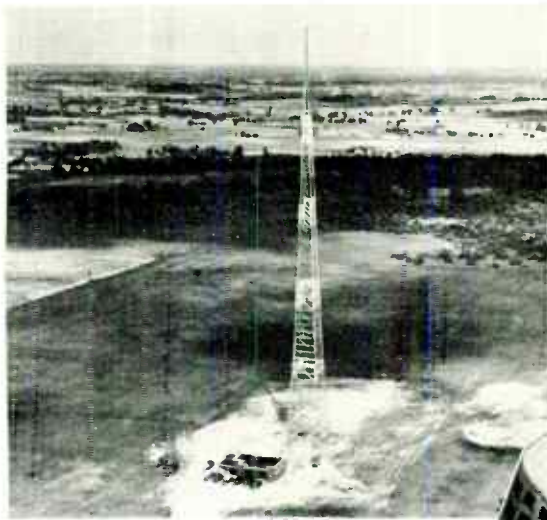


**BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.**

In Canada: RCA VICTOR Company Limited, Montreal



Ready for mounting



Installed

simply as this

the FM PYLON

DATA FOR RCA PYLON ANTENNAS STANDARD PYLONS

Type No.	Nominol Power Gain	Sections	Overoll Height (ft.)	Weight (lbs.)
BF-11A/B	1.5	1	13.5	350
BF-12A/B	3.0	2	27	700
BF-14A/B	6.0	4	54	2000
BF-18A/B	12.0	8	108	12497

HEAVY-DUTY PYLONS

BF-12E/F	3.0	2	27	4322
BF-14C/D	6.0	4	54	10497

LOW-POWER PYLONS

BF-21A/B	1.5	1	13.9	376
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The RCA Pylon Antenna



By all means, mail this coupon

Engineering Products Dept. 38-A,
Radio Corporation of America
Camden, New Jersey

Please send me, without obligation, a copy of the new brochure on your complete line of Pylon antennas.

NAME _____

ADDRESS _____

STATION _____

CITY _____ STATE _____

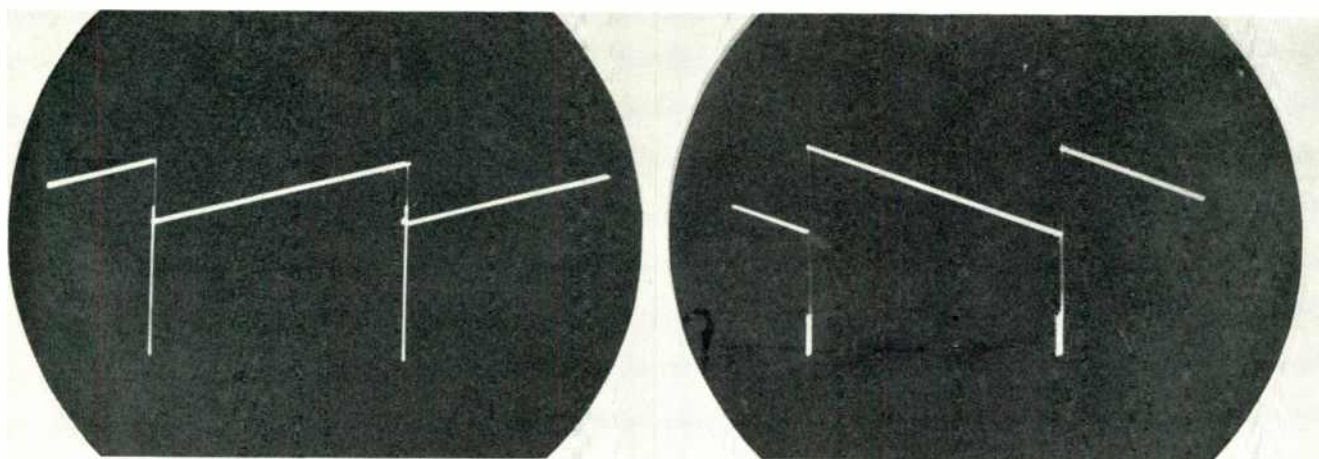


FIG. 1, LEFT: OSCILLOSCOPE PATTERN OF A SAWTOOTH WAVE PRODUCED BY THE SWEEP FREQUENCY UNDER NORMAL OPERATING CONDITIONS. FIG. 2, RIGHT: CHANGING THE PROBE FROM GRID TO PLATE REVERSES THE PATTERN ON THE TUBE

With this type of probe, connections can be made safely to all except the high voltage points in the television receiver. When working in the RF or IF section it is advisable to use a shielded lead and to ground the shield on the 'scope as well as at a point on the television chassis preferably near the hot point being observed. The points where connections are usually made are the grid and plate pins of the various tubes. For this purpose either a clip of some kind or a hook may be used. It is good practice to make one good ground connection and then move only the hot lead.

Before trying to analyze any waveform, it must always be kept in mind that the 'scope shows only voltage and not current waves, unless it is connected across a pure resistance, when voltage and current are in phase. Peak current must then be calculated by Ohm's Law.

Trouble-Shooting ★ The first steps to be taken when trouble-shooting a television receiver is to observe the symptoms and to get a rough idea in which section the defect might be located. Eliminating the obvious power supply failures, look to the picture tube for some indication.

If only a vertical line appears, the trouble is most likely in the horizontal

sweep section. A horizontal line, on the other hand, points to the vertical sweep section. A good raster but no picture might indicate trouble in the video amplifier, IF, or RF stages. Or, if the sound signal can be tuned in but no picture can be seen, that would limit the area under suspicion to the video and IF stages. And that is the point when you start to use the oscilloscope for tracing.

Sweep Circuits ★ Assuming that either of the sweep circuits does not function properly, set the 'scope sweep frequency to either 60 cycles or 15,750 cycles, depending on the frequency of the circuit under observation. Next, put the vertical output lead, with the probe mentioned previously, on the plate pin of the last sweep amplifier tube. If you see no sawtooth wave there, as Fig. 1, move to the grid of that tube. If you still do not get the expected pattern on the 'scope, continue to check preceding grids and plates.

Finally, you come to the oscillator, which will be either of the blocking type or a multivibrator. If the 'scope shows no output there, you can be sure that the trouble is in that circuit, and voltage and resistance analysis will quickly locate the defective part.

In tracing a voltage wave through a

circuit, it should always be remembered that an amplifier will invert the wave shape. For instance if you see a pattern as in Fig. 1 from the grid of an amplifier, you should get the upside down picture, Fig. 2, at the following plate.

Raster but No Picture ★ If the television screen shows a raster, but is unable to hold the picture, you must assume a defect in the synchronizing circuits. If the picture moves up or down, the vertical or 60-cycle sync pulse may be missing. Otherwise, you would check on the horizontal or 15,750-cycle pulse. These pulses should appear on the grid of the multivibrator or blocking oscillator as shown in Fig. 3 or 4. Traced back through the sync amplifiers, they will be inverted between grid and plate.

Should the inversion be missing, chances are that particular tube is not operating properly and, again, a voltage check or new tube will take care of this trouble.

It is also possible, by calibrating the 'scope as shown previously, to measure the gain of each stage quite accurately. After working with the 'scope for a while, it will become very easy to visualize just what takes place in each circuit and what must be defective to produce the particular trouble.

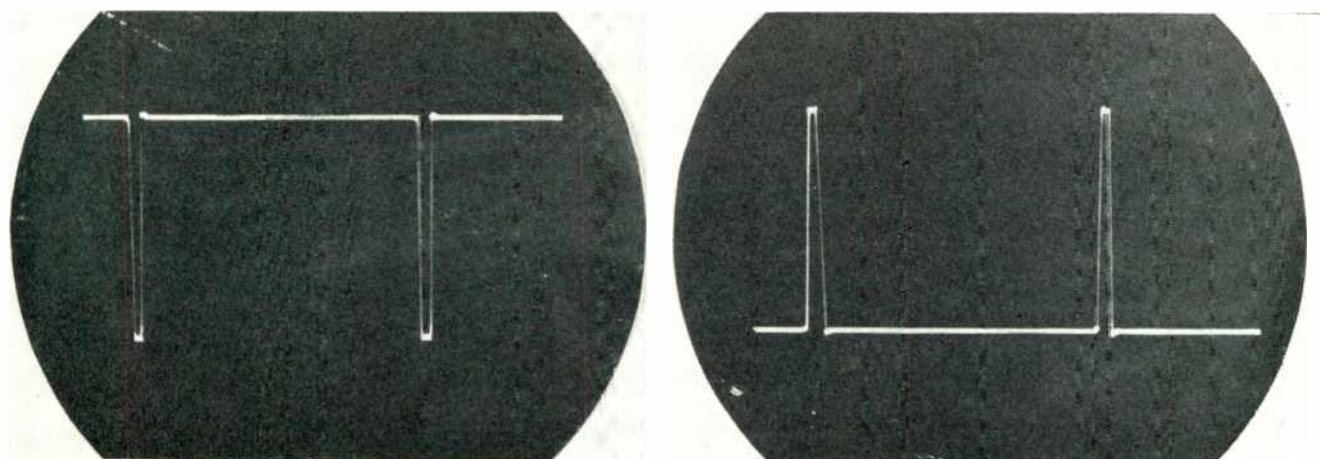


FIG. 3, LEFT: PATTERN OF THE SYNCHRONIZING PULSES GENERATED AT THE GRID OF THE MULTIVIBRATOR OR BLOCKING CONDENSER. SUCH PULSES MAINTAIN THE VERTICAL AND HORIZONTAL PICTURE SYNCHRONIZATION. FIG. 4, RIGHT: INVERSION AT PLATE

Especially when dealing with difficult circuits, such as the automatic frequency control systems used to keep the horizontal sweep in synchronism, the 'scope is often the only way trouble can be spotted. For instance, most automatic frequency control systems are based on a principle using a feedback sawtooth voltage which is changed into a square wave by an *R-C* network. If one of the condensers is open, the change will not take place, and although the feedback signal is still applied to the frequency discriminator, it does not have the proper shape. Thus the automatic frequency control will not work or will be only partially effective. Signal tracing these circuits with the 'scope will show up such a defect quickly.

When a raster, but no picture appears, although the sound can be heard, then the trouble must be in the video amplifier or IF sections. Putting the probe on the grid of the cathode ray tube, you will probably find no signal. It is best to trace

indicates oscillation or a transient, and will probably be visible also on the television picture. Naturally the picture signal can only stand still when a fixed pattern is being transmitted.

It is also possible, by use of the 'scope, to check the action of the DC restorer. To obtain the proper television picture, it is necessary that the signal going on the grid of the cathode ray tube have a DC component, and that all pedestals or pips be lined up as in Fig. 6. Since a coupling condenser always blocks off the DC component, a diode is frequently used to reinsert the proper DC level. If the 'scope pattern, with the lead on the picture grid of the cathode ray tube, does not show straight lines as in Fig. 6, then DC restoration is not taking place. A voltmeter or ohmmeter check will usually be enough to locate the defective component.

Hum Detection ★ Another application for

the second anode. Those oscillators usually operate at about 200 kc. They are well shielded and thoroughly decoupled to prevent any RF from interfering, but if the decoupling condensers open up, or chokes short, RF interference may become really objectionable.

It will show up as a net-like pattern moving back and forth over the regular television picture. Putting the 'scope lead on the B supply, you can easily see if any RF is present that might be coupled into the video section. If the B supply appears clean, try the filament voltage. Next, fashion a small loop of 4 or 5 turns out of regular hook-up wire and clip the 'scope lead to one end. Move this around the RF supply shield can and see if the 'scope shows any RF being picked up.

Sometimes poor grounding of the shield can cause leakage through the air. Many small electrostatic-type television sets use a 60-cycle high-voltage supply and a

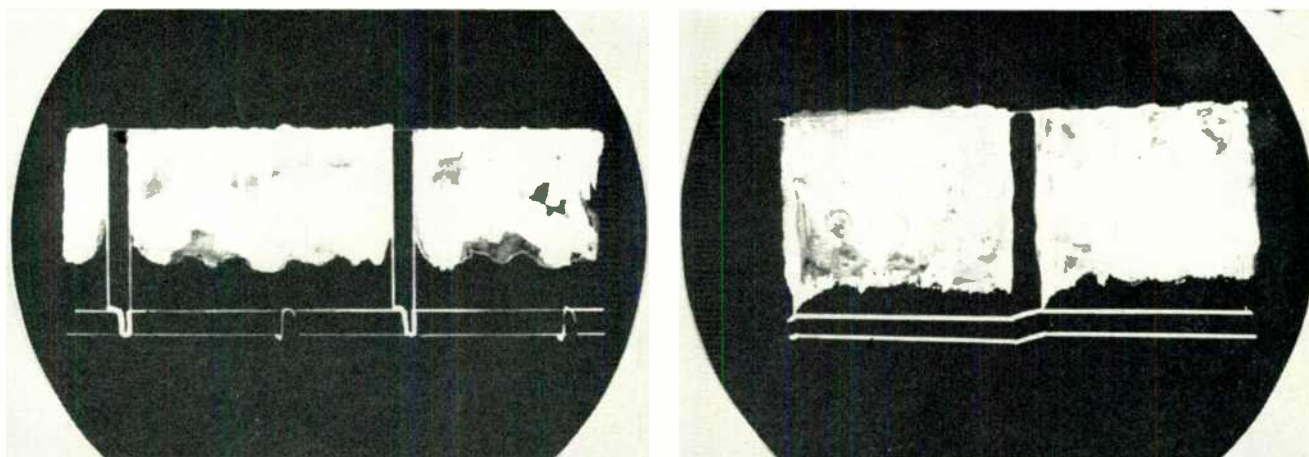


FIG. 5, LEFT: OSCILLOSCOPE PATTERN AT THE OUTPUT OF THE SECOND DETECTOR. IN THIS CASE THE 'SCOPE IS SET AT 60 CYCLES. FIG. 6, RIGHT: RESULTS WHEN 'SCOPE IS SET AT 15,750 CYCLES. STEAM-LIKE CLOUDS ARE CAUSED BY PICTURE SIGNAL

the signal back through the DC restorer, last video amplifier, and first video amplifier until you come to the output of the second detector. If the loss of signal occurs in the video stages, there should be something on the 'scope before you reach the detector. The 'scope pattern will look like Fig. 5 or 6, depending on whether the scope is set to 60 or 15,750 cycles. At 60 cycles, you will be able to see small vertical lines, representing the horizontal sync pulses, but sometimes these small pulses may appear only as two parallel horizontal lines as in Fig. 6. These horizontal lines represent the many small dots caused by the sync pips shown in Fig. 5. The irregular pattern between sync pulses is the picture signal. On the 'scope it will appear like steam clouds shaped by a brisk wind, in some places dense, and light in others.

If the circuit is functioning properly, it should be possible to vary the height of the picture signal by varying the contrast control. The picture signal should stand perfectly still with respect to the sync pulses, and any small vertical wiggle

the 'scope is in the detection of hum, interference, and leakage. It may happen, for instance, that the television picture has a dark, broad band running through its center. Placing the 'scope lead on the grid of the cathode ray tube, you may find that instead of the proper straight lines you have a picture signal apparently riding on a sine wave.

Probably, this will be a 120-cycle wave, coming from the B supply and caused by bad filtering, an open decoupling condenser, or some other circuit failure. Or the sides of the picture may have a sine wave shape instead of being straight lines. Looking at all the grids and plates of the vertical sweep circuits you will encounter one point that does not show a large 120-cycle sine wave component. That indicates the source of this trouble.

Sometimes the vertical sync pulses or sawtooth voltages interfere with the horizontal and vice versa, and there again the 'scope is the only reliable test instrument.

Some television receivers use an RF oscillator to provide the high voltage for

high-voltage condenser from the output of the sweep amplifier to the deflection plates which are at a high DC potential. If that condenser develops leakage, it will introduce 60-cycle modulation on the plate of the amplifier. Therefore, if that is suspected, a quick check with the 'scope on the plate of that output amplifier will determine the amount of 60 cycle AC.

Constant use of the 'scope will result in not only faster and more accurate servicing, but it will enable the serviceman to find many more applications and uses for this instrument than could possibly be listed here. To use the 'scope to the very best advantage, it is necessary to have a diagram of the particular set and also the manufacturer's notes with instructions for special circuits. Most of these service notes for television sets contain a number of 'scope patterns which should appear at certain points. This makes trouble-shooting much easier, but it is still true that practice and still more practice is required to master the problems of servicing modern television receivers.

SELECTIVE CALLING FOR MOBILE TELEPHONE SERVICE

How the Automatic Selector Responds to the Dialing of Its Number at the Central Station

BY B. P. COTTRELL *

WHEN 2-way mobile communications were first employed between headquarters transmitters and their associated groups of cars, as in police radio systems, the operator in each car heard all the messages transmitted from his station, both those that were intended for him, and those that were not.

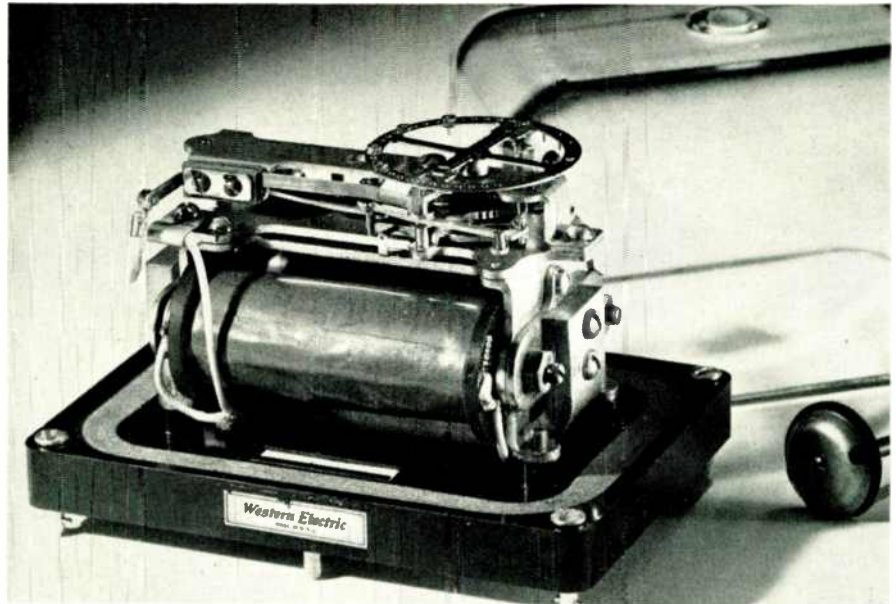
Over a period of years, the use of 2-way radio has spread to many new kinds of services. In some systems, it is still considered advantageous for all car operators to hear all messages. In others, there are reasons which make it desirable to limit the response of a car installation to messages intended for the driver of that car.

This is particularly true of urban and highway systems operated in conjunction with the Bell Telephone System. It also applies to installations serving different kinds of subscribers in given areas.

To meet this need, the Western Electric 106A selector set has been developed. This selector is built into Western Electric type 38 mobile radiotelephone equipment Fig. 1, and is also available as a separate unit for use with any make of 2-way units.

Use of the Selector ★ The selector set is installed in conjunction with the 41A control unit, Fig. 2. The control, mounted on the dashboard of a car or truck, provides a hang-up for the handset, a control switch actuated when the handset is removed or put in place, a power switch to turn the radio equipment on or off, a signal light to

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THE SELECTOR RELAY IS AMAZINGLY RUGGED, DESPITE ITS DELICATE CONSTRUCTION

show when the power is on, and a light which flashes when the car is being called. A call bell can be furnished, also. The function of the selector is to operate the light or bell when, and only when the code number of the car is dialed by the central station operator.

If the driver of the car wants to place a call, he picks up the handset and listens to make sure that no one else is talking. Then he presses the push-to-talk button on the handset, and gives the operator the number he wants to reach. Pushing the button switches on the car transmitter and keeps it in operation until it is released.

Operation Selector Unit ★ Fig. 3 shows the separate 106A selector set, while Fig. 4 illustrates the method of mounting the selector in the mobile receiver chassis.

The heart of the system is a glass-enclosed, polarized relay, Figs. 3 and 4. The armature, drawn alternately to one pole and then the other by impulses picked up by the radio receiver, causes a light brass wheel to be ratcheted around. If the relay-actuating pulses turn the wheel to the proper point, the light on the dashboard control box signals the driver that there is a call coming in for him. Of course, the system is not quite that sim-

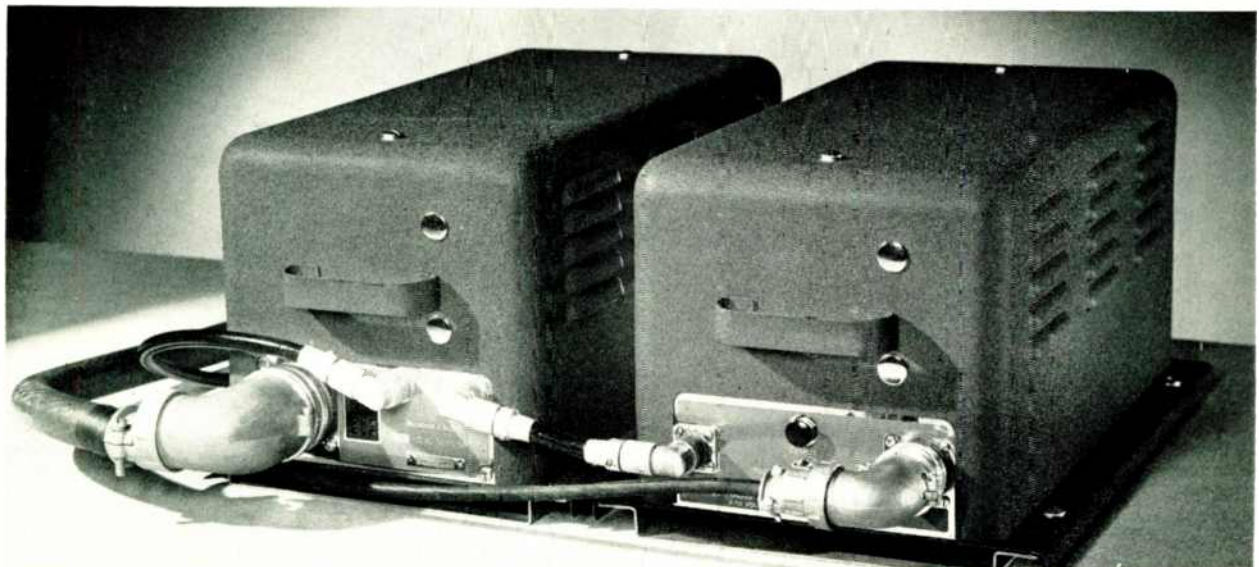


FIG. 1. FM TRANSMITTER, LEFT, AND THE RECEIVER USED IN WESTERN ELECTRIC MOBILE COMMUNICATIONS INSTALLATIONS

ple. Here are the details of the equipment, and the method of operation:

Each car is assigned a code number comprised of five digits, such as 26753. The digits in each code number must add up to 23. Code impulses are transmitted by dialling at the central station. The impulses for each digit of the code are 600- and 1,500-cycle tones, transmitted alternately.

The selector device, Figs. 3 and 4, is driven by a 2-core relay whose pivoted armature is drawn alternately toward one core, and then the other. This armature action, resulting from the alternate transmission of the two audio frequencies when each digit is dialed at the central office, rotates a ratchet wheel mounted on the same shaft with a code wheel. The code wheel carries 4 small stop pins which correspond in position to the code number of the car. These are set in their proper holes when the mobile equipment is installed. In addition, there is a fixed pin representing, in its position, the 23rd impulse of the code number, and an additional fixed pin used under special conditions with a 25-impulse code.

When the first digit of the code has been dialed, the code wheel will return to normal (under the action of a spiral spring) unless the code wheel has been advanced to the exact position of the first stop pin. In this case, the first stop pin is caught by the half cylindrical end of a light holding spring. As soon as the next digit is dialed, the selector relay is again operated and the stepping of the code wheel is resumed. If, at the end of the second digit, the second stop pin is not reached, the code wheel will then return all the way to its normal or starting position. If the second stop pin is reached, the code wheel will be held until the next digit is dialed. This action continues with the dialing of the third, fourth, and fifth digits.

Only the selector set for the number dialed will be advanced to the fifth pin.

Fig. 5, to selector terminal 6 and the corresponding local circuit.

The selector is designed to operate on dial speeds of from 8 to 11 pulses per second which, in this application, results in from 8 to 11 tone frequency interchanges per second.

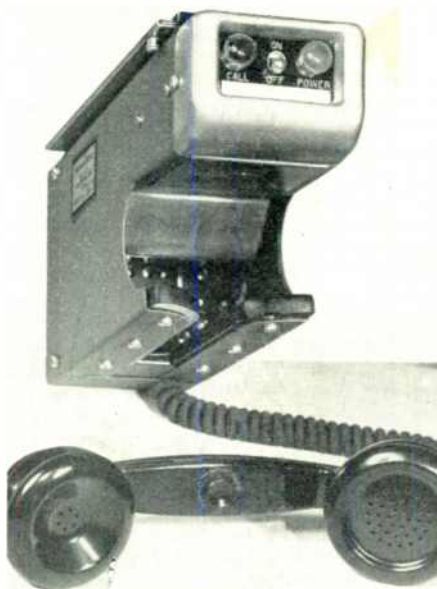


FIG. 2. DASHBOARD CONTROL UNIT

At the end of the transmission of a call signal, the contact wheel in only one selector will have moved the full 23 stops, but others may be holding in various positions of advancement between 2 and 21 stops. In order to insure proper selection of the next call it is necessary that all selectors be reset to the normal position. A single pulse, when received by the selector, acts as a clearing out signal and resets all selectors to starting position. The control terminal equipment is arranged to send automatically a single pulse preceding each transmission of a signalling number. Use of the digit 1 for

Circuit Functions ★ Fig. 5 shows a diagram of the complete system. The input circuit from the radio receiver is applied to transformer T1 under control of the auxiliary relay S4. The transformer output is fed through capacitor C1 and resistor R6 to the two selective circuits L1-C2 and L2-C3-C4 in series. The first selective circuit passes each 600-cycle pulse to the full-wave rectifying varistor RV1; and the second, passes each 1500-cycle pulse to the full-wave rectifying varistor RV2.

The DC outputs of the varistors alternately energize the opposed windings 3-6 and 2-7 of the polarized relay S1 as the alternate 600- and 1500-cycle pulses are received. The direction of current in the bias winding 1-8 is reversed at each operation of the relay so that this winding tends to maintain the armature in the last position to which it was drawn. The 80-volt power source for this bias winding is taken from a voltage divider R4-R5 through resistor R2 or R3 under the control of the relay contacts. The operation of relay S1 alternately applies 160 volts to capacitor C5 to charge it, or connects it to ground to discharge it. These two conditions cause current to flow alternately in opposite directions through the windings of the stepping relay of selector S2, the armature of which is drawn first to one side and then to the other, stepping the selector code wheel around at a rate corresponding to the dial speed of 8 to 11 pulses per second.

At the completion of the proper 5-digit code totalling 23 pulses, the code wheel contact rests on terminal 6, and the 6-volt supply is applied to operate the subscriber's bell and the relay S3 controlling the call lamp. The stepping relay armature returns to its neutral position as soon as the capacitor C5 is fully charged or fully discharged. The code wheel, however, is held mechanically in its final position until the stepping relay armature is again operated as will be described later.

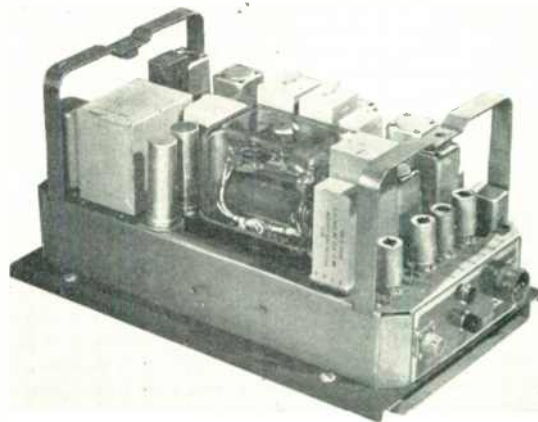
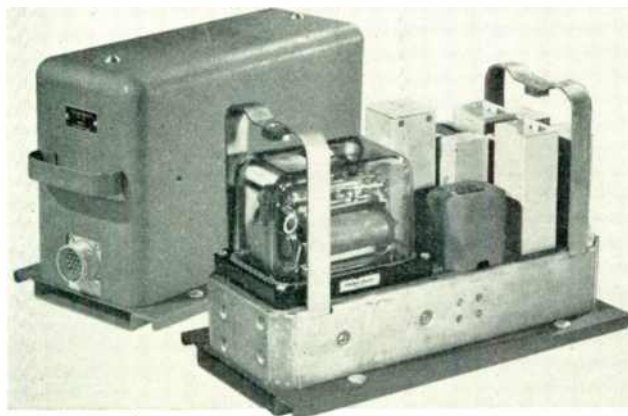


FIG. 3. LEFT: SELECTOR SET FOR USE WITH ANY MAKE OF EQUIPMENT. FIG. 4, RIGHT: SELECTOR SET ON A W.E. RECEIVER

Then a spring contact mounted on the code wheel, will hold the fifth pin, and keep the wheel from returning to its starting position. The local electrical circuit is then completed from selector terminal 5,

clearing the selectors precludes its use as a part of the signalling number. These numbers are therefore limited to permutations of the digit 2 through 0, the sum of the five digits always equaling 23.

The bell will ring as long as the code wheel remains in its final position. This is normally 3 to 4 seconds as governed by an automatic timing circuit at the point where the selective signalling oscillator is lo-

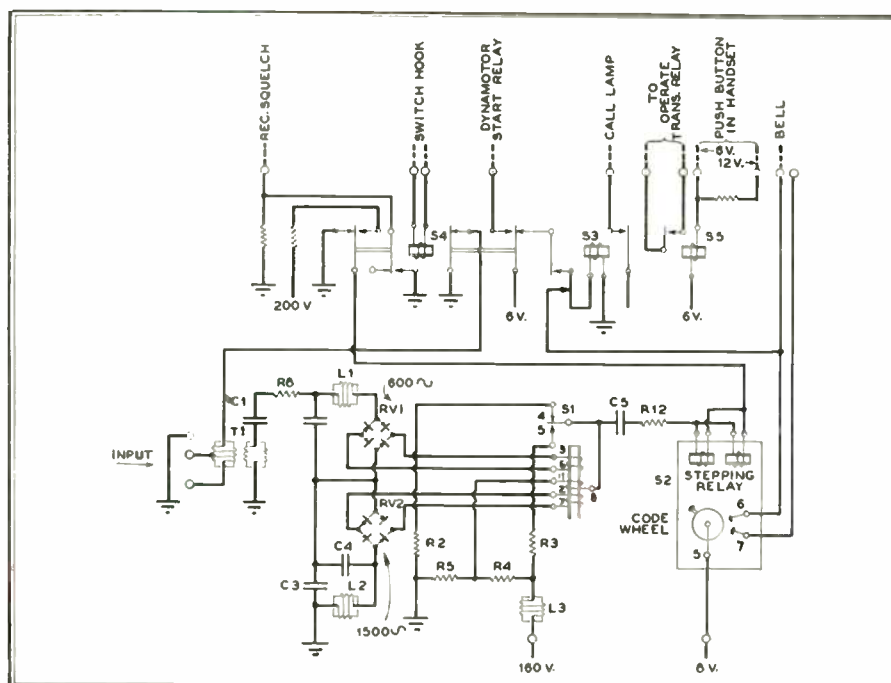


FIG. 5. SCHEMATIC DIAGRAM OF THE MOBILE SELECTOR AND ASSOCIATED CIRCUITS

cated. The lamp remains lighted until relay S4 is operated by the removal of the handset from the switchhook. This operation will also shut off the bell if it has not already stopped ringing.

From the standpoint of the selector set, the detailed action is as follows:

1. The number 1 is always transmitted first, on 1,500 cycles, by the land station selective signalling equipment as a clearing signal. This is not considered a part of the code. This is done so that every selector code wheel is advanced one step and then released to return to its normal position. This step is necessary before the code number proper is transmitted. When the initial 1,500-cycle tone is received, it is rectified by varistor RV2 whose output energizes winding 2-7 of relay S1.

The armature of this relay is drawn to its contact 5 and held there by the action of the biasing winding 1-8. In this position of the armature, which is the same whenever the 1,500-cycle tone is being received, the capacitor C5 is charged by current flowing from the 160-volt DC source through the retard coil L3, resistor R5, the capacitor, and the windings of the stepping relay of the selector S-2. This charging current causes the armature of the stepping relay to be drawn toward one pole and to step its code wheel one step. As soon as the condenser has become charged and the charging current ceases, the armature of the stepping relay returns to its normal position. The code wheel also returns to its normal position unless it is stepped again in a minimum time by a reversal of the armature, or unless it contacts a stop pin. There is never any stop pin in a code wheel position 1, or in adjacent pin position, by which the code wheel may be held.

2. The first impulse transmitted in the 5-digit code from the distant telephone

exchange office at the start of transmission is always the 600-cycle tone. The armature of relay S1 is drawn to its contact 4 and held there by the action of the biasing winding 1-8. In this position of the armature, which is the same whenever the 600-cycle tone is being received, ground is applied to discharge capacitor C5, in series with the winding of the stepping relay, and connected to ground over the contacts of the unoperated relay S1.

3. The selector set is now ready to respond to its particular code by having its stop pins caught in succession by its holding spring as the digits of its code are dialed. The code wheels of other selector sets will be stepped up from their normal positions as each digit is dialed, but will be returned to their normal positions at some time during the transmission of the digit code. Only the wheel coded for the number dialed will reach the final stop pin.

The choke coil L3 tends to prevent disturbance on the 160-volt DC source when relay S1 operates.

The auxiliary relay S3 is operated when the code wheel reaches the final position of a 23 pulse code and locks up over contacts of auxiliary relay S4 so as to keep the call lamp lighted in the control unit until the subscriber's handset is lifted from the switchhook.

When relay S4 is operated it connects a 160-volt DC supply to the windings of the stepping relay of selector S2 to return the code wheel to normal, if it has not already been returned. This relay can also be used to perform other functions. In some mobile sets, for example, it is used to connect a 6-volt DC supply to a radio transmitter power relay that starts the dynamotor in the transmitter, to open the incoming circuit from the radio receiver to the selector set, and to short-circuit a

resistor in the grid bias supply of the squelch circuit in the radio receiver so as to make the squelch circuit less sensitive to noise during the talking and listening interval.

The S5 relay is provided to permit the use of a lighter and more flexible cord to the handset than would be required if the DC supply to the transmitter were carried through the cord.

FM FOUGHT FOREST FIRES

(CONTINUED FROM PAGE 26)

WRPT to all cars and police departments: be on the lookout for a New York car, license - - - -, Driver reported acting very suspicious. Just came across Maine border, may be setting fires along Route No. 302.

No. 50 to WRPT: horse and wagon just came down the road with man badly burned and wagon on fire. Have administered first aid, and taken subject to doctor, but don't think he will live.

WRPT to WIII. Rochester police and fire departments: Concord fire department is sending engine No. 4 to give you assistance.

No. 201 to WRPT: fire on Route No. 11 has crossed the road, and is endangering farm buildings.

These typical messages, numbering over 4,000 in a week's time, indicate the part played by our radio system in that great battle against forest fires. Through it all, the equipment performed without the loss of a single message. Our one weakness was lack of portable units for use at the fire fronts. This was pointed out in an editorial in *The Granite State News*, Wolfeboro.

" . . . The need for better communications on the fire line was proved over and over again. Looking through the smoke and darkness for a Fire Warden, pump foreman, or Fire Chief wasted much valuable time. When a fire can be measured in feet or yards, then word of mouth will serve. But when a fire front is measured in miles, then there is a real need for efficient radio communication. The ideal setup would be for each Fire Warden, Fire Chief, and pump crew to have one man doing nothing but standing by with a walkie-talkie radio. A man standing by with a radio would not seem to be doing much, but when he did work, his efforts would save hundreds of man-hours of wasted work. Every man directing the fight should have a communications man at his elbow all the time."

Our experience in getting water, equipment, and manpower to the separate fire-fighting groups, and in coördinating their activities confirms this opinion. We plan to explore the possibilities of portable radio units for use by the State Police, and we shall present the information to municipal police and fire departments, with a view to perfecting our communications in New Hampshire to this last detail.

U. S. COMMUNICATIONS SYSTEMS, PART 2

Systems Operated by Utilities, Trucks, Buses, Taxis, and Special Services, Revised to Dec. 1, 1947

PUBLIC UTILITIES

Adams Elec Lt Co 34 Spring St	3 WJSO	39.66	MF
Adams NY			
Adams-Marquette Elec	5	39.66	MF
Adams-Marquette Elec			
Albany Elec Coop	10		GF
Albany SC			
Alabama Elec Coop River Falls	5 WEOT	31.46	MF
Alabama Ala			
Alabama Pr Co 111 Dexter Ave	50 WGHA	37.86	MF
Alabama Ala			
Alcorn City Elec Pr Cruise & Jackson	3 WNAV	30.86	GF
Alcorn Miss			
Alamankoe Clayton Elec Coop	7 KSWX	39.66	MF
Alamankoe Va			
Alamankoe Elec Membership Corp	6 WUAC	37.62	GF
Alamankoe Va			
Anoka City Coop L & P Assn	6 KGVV	33.34	MF
Anoka Minn			
Appalachian Elec Pr Co	104		MF
Appalachian Elec Pr Co			
Bluefield WVA	WATL	31.46	MF
Bluefield WVA	WATL	31.46	MF
1002 3rd Ave Huntington WVA	WHTY	31.46	MF
Cabin Creek Junction WVA	WKJL	39.66	MF
301 Virginia Charleston WVA	WMOH	31.46	MF
306 S Kanawha Beckley WVA	WNPY	31.46	MF
328 Walnut Av Roanoke Va	WRIS	31.46	MF
State Rt 57 nr Eldfield Va	WVEX	39.66	MF
523 Main Lynchburg Va	WVFX	31.46	MF
Main St Stuart Va	WVHR	39.66	MF
Arkansas Pr & L Co 600 Garland Av	KHQL	31.46	MF
Arkansas Pr & L Co			
Little Rock Ark	KHQL	31.46	MF
Stuttgart Ark	KHQL	31.46	MF
Atlanta Gas Lt Co 220 2nd St	50 WKAE	33.02	MF
Macon Ga			
1240 Caroline St Atlanta Ga	WKAG	33.02	MF
235 W 1st St Rome Ga	WKAH	33.02	MF
Atlantic City Elec Co Cohamsey St	44 WDEH	39.66	MF
Bridgeport NJ			
Mo Av Atlantic City NJ	WMIW	39.66	MF
Spicer & NJ Aves Wildwood NJ	WMDK	39.66	MF
Atlantic Seaboard Corp US Rt 240			
Westmore Md	3 WNKI	39.66	MF
Barton City Elec Coop Office Bldg	6 WUAD	39.66	MF
Barton Wis			
Bartholomew City Rural Elec Mem Corp	1 WKQA		
Columbus Ind			
Barton City Elec Coop	12 KIWY	153.59	MF
Lamar Mo			
City of Beaumont Tex Louisiana & Pine	35 KETN	31.46	GF
Beaumont Tex			
Beaumont Tex	KSEB	31.46	GF
Belmont Elec Coop Inc St Rt 40	3 WQZD	33.82	MF
Chattanooga Ohio			
Benton City Pub Util Dist 211 Kennelick Av	8 KRPV	30.86	GF
Kennewick Wash			
1209 Mend St Prosser Wash	KRPV	30.86	GF
Birmingham Gas Co 2501 N 29 St	1 WBNH	31.46	Ma
Birmingham Ala			
1200 6th Ave Birmingham Ala	WBNH	31.46	Ma
B-K Elec Coop Inc Cor Wash & Pecan	7 KAVT	37.74	GF
Seymour Tex			
Blackstone Valley G & E Co Jenks Lane St	19 WQHG	39.66	GF
Pawtucket RI			
Villa Nova St Woonsocket RI	WQHG	39.66	GF
Blue Ridge Elec Memb Corp	25 WUAT	37.70	GF
Blowing Rock NC			
Nr Boone NC	WUAT	37.70	GF
Clifton NC	WUAT	37.70	GF
Elfin NC	WUAT	37.70	GF
Mulberry St Lenoir NC	WUAT	37.70	GF
Sparta NC	WUAT	37.70	GF
West Jefferson NC	WUAT	37.70	GF
Boone City Ru Elec Memb Corp	5 WQHW	39.66	MF
Lebanon Ind			
Boston Cons Gas Co 144 Melrose St	16 WIDDE	39.66	MF
Boston Mass			
Boston Edison Co 175 Alfred St	25 WAAE	39.66	MF
Boston Mass			
87 Bridge St Weymouth Mass	WAZB	39.66	MF
1205 Commonwealth Av Boston	WAZC	39.66	MF
776 Summer St Boston	WAZD	39.66	MF
660 South St Boston	WAZE	39.66	MF
182 Tremont St Boston	WAZI	39.66	MF
325 Cambridge St Boston	WAZK	39.66	MF
19 South St Framingham Mass	WJDT	39.66	MF
Cove St Woburn Mass	WQWP	39.66	MF
1165 Mass Ave Boston	WJDT	153.59	MF
Brazos R Trans Elec Coop Inc Highway 377	10 KHRF	2.726	Wa
Granbury Tex			
Brooklyn Edison Co 150 Summer St	30 WLEK	31.46	GF
Brooklyn Mass			
Grove St Brooklyn Mass	20 WKNH	33.22	GF
The Brooklyn Union Gas Co 8322 Ditmars Av	100 WNVG	39.98	MF
Brooklyn NY			
City of Buffalo NY Water Intake Crb			
Buffalo NY	WBQH	39.66	Ca
Flt Plant Jersey St Buffalo	WBQO	39.66	Ca
Buffalo Niagara Elec Corp 93 DeWey	10 WALI	31.46	Ma
Buffalo NY			
Calif Elec Pr Co Contr Sta	1 KAMB	31.46	MF
Nr Bishop Calif			
Sub-sta Leevining Calif	KAEI	31.46	MF
California Calif	KGJD	31.46	MF
Bythe Calif	KGJD	31.46	MF
Donoghue Calif	KGJD	31.46	MF
Contr Sta Bishop Calif	KGYF	31.46	MF
Calif Ore Pr Co 209 N 6th St	71 KCVY	39.66	MF
Grants Pass Ore			
270 1st Crescent City Calif	KCVZ	39.66	MF
N End Mills St Klamath F Ore	KKLB	39.66	MF
Es Main St Alturas Calif	KKLE	39.66	MF
Lakeview Ore	KKLE	39.66	MF
Dixonville Ore	KKUC	39.66	MF
Roseburg Ore	KKUF	37.58	MF
Callaway Elec Co 10 E 14th St	4 KAWR	153.65	MF
Pulmon Okla			
Cambridge Elec Lt Co 351 3rd St	20 WUTR	158.25	MF
Cambridge Mass			
Canadian R Gas Co Cor Polk & 3rd St	1 KCRP	39.98	GF
Amariillo Tex			
Dalhart Camp Dalhart Tex	KCRN	39.98	GF
Elvins Camp Dalhart Tex	KCRN	39.98	GF
Caprock Elec Coop Inc 409 St Peters St	5 KWEP	37.74	MF
Stanton Tex			

SPECIAL INFORMATION

1. Addresses are for the headquarters operating points, except for a few cases where such mailing addresses were not available from FCC records. Then, address given is for the company which owns the station.

2. The number following the address is for the total number of mobile transmitters in the system. In some instances, FCC records did not list mobile units. Hence, there is no number shown here.

3. Call letters, for the most part, are for the main stations. In most cases, the same letters are assigned to fixed and mobile transmitters. Some systems have different call letters assigned to groups of mobile transmitters. To conserve space, these extra call letters are not shown unless different frequencies are assigned.

4. Frequencies are given in megacycles.

5. The capital letter at the right shows the make of equipment used. If two or more makes of equipment are used at a station, the name of the principal supplier is shown. These are:

A: Radio Corp.	K: Kaar
B: Bendix	L: Link
C: Collins	M: Motorola
D: Doolittle	R: Raytheon-Belmont
E: General Electric	T: Temco
H: Harvey Radio Labs	W: Western Electric

6. The small letter at the right indicates frequency or amplitude modulation.

Cape & Vineyard Elec Co 396 Main St	19 WJKN	39.66	MF
Hyannis Mass			
Capital Elec Pr Assn	12 WMQB	33.34	MF
LPA Office Clinton Miss			
Carroll City Pr & L Co 3 Manning Av	8 WJSQ	37.62	MF
Sumter SC			
Portable	2 WJUL	39.66	La
Asheville NC			
Greenville SC	WUGA		
Greenville SC	WUGI		
Carroll City Ru Elec Memb Corp 109 E Franklin	10 WJOT	153.59	MF
Delphi Ind			
6 WJOT			
8 Lisbon St Carrollton Ohio	WGOH	37.54	MF
Mobile	10 WGOJ	36.54	MF
Central Ariz Lt & Pr Co Service Bldg	60 KLOT	153.59	MF
Phoenix Ariz			
Steam-Elec Sta Phoenix Ariz	KIOY	153.59	MF
2nd Av & Buchanan S Phoenix	KSKE	153.59	MF
Central Elec Coop Inc	10 WJOT	37.62	GF
Parker's Landing Pa			
Central Hudson G & E Corp 4th Av	161 WAWN	75.66	MF
Catskill NY			
26 E O'Reilly St Kingston NY	WAWZ	75.66	MF
284 So Av Poughkeepsie NY	WAVS	75.66	MF
256 Hwy Newburgh NY	WAVV	75.66	MF
Central La Elec Co Inc Main St	4 KCOV	39.98	MF
Villa Platte La			
Main St St Landry La	KCOV	39.98	MF
Main St Bunkie La	KCOV	39.98	MF
Main St Calfax La	KCOV	39.98	MF
Main St Mansura La	KCOV	39.98	MF
Shamrock St Pineville La	KCOV	39.98	MF
Oakdale La	KCOV	39.98	MF
Central Mass Elec Co 465 N Main St	16 WHPV	31.46	GF
Palmer Mass			
Central NY Pr Corp	11 WJMD	31.46	GF
Orisco NY			
725 Oswego Hwy Syracuse NY	WPAE	31.46	GF
Central Pa Lt Co La Palma Pr Plant	33 KQPI	39.66	GF
San Benito Tex			
Corpus Christi Tex	KIRQ	39.66	GF
1307 Van Loan St Corpus Chr	KRMV	39.66	GF
Central Valley Elec Coop Inc 1109 W Merchant	3 KVOB	39.98	GF
Artesia N Mex			
Central Va Pub Serv Corp 19 Cleveland Av	27 WJET	39.66	GF
Sherborn (Rutland) Vt			
CVPSHC Hydro Sta Royalton Vt	WJET	39.66	GF
Hogback Rd Cavendish Vt	WJET	39.66	GF
CVPSHC Hydro Sta Bradford Vt	WJET	39.66	GF
Lafayette St Claremont NH	WJET	39.66	GF
CVPSHC Substa Bennington Vt	WJET	39.66	GF
City of Chattanooga Tenn Oak & Greenwood Sts	17 WBMH	31.46	MF
Chattanooga Tenn			
Oak St & Greenwood Av Chatta WBPY			
City of Chillicothe Mass 725 Front St	10 WJPI	30.86	GF
Chillicothe Mass			
Choctawhatchee Elec Coop Inc 5th & Gay Sts	1 WGHF	39.98	GF
Denton Md			
Chalabonne Elec Coop Inc Ruston Highway	6 KBNF	31.46	GF
Home La			
Farmerville La	KBNF	31.46	GF
Clark Elec Coop	WQAA		
Greenwood Wis			
Clay City Elec Coop Corp City Water Tower	10 KANE	47.58	MF
Corning Ark			
Clay Elec Coop Inc Thrush St	15 WKRA	37.86	GF
Keystone Hts Fla			
Clay-Culion Elec Corp 119 E Main St	6 KTHF	47.66	GF
Vermillion SD			
Cleveland Elec Bldg Co 75 Public Sq	150 WTJT	35.14	MF
Cleveland Ohio			
1737 Main St Ashtabula Ohio	WTJW	35.14	MF
Coast City G & E Co End of Blaine St	11 KAEY	39.66	GF
Santa Cruz Calif			
Valer St Watsonville Calif	KAFB	39.66	GF
RR Av Gilroy Calif	KAFB	39.66	GF
7th & E Sts H Altster Calif	KFLI	39.66	GF
Co to Central Pr Co 3470 S Bway	20 KRYD	33.30	GF
Endwood Colo			
Colorado Interstate Gas Co Natl Bank Bldg	10 KHGF	39.98	GF
Colorado Springs Colo			
Anyon Comp Station	KHGF	39.98	GF
Devine Comp Station Pueblo	KHGF	39.98	GF

Gilmarron Comp Sta Clay NMEX	KHHG	39.98	GF
Clayton Comp Sta Clayton NM	KHJH	39.98	GF
Nr Lakin Kans	KPMH		
City of Columbia Tenn 212 W 7th St			
Columbia Tenn	WDDW	37.54	MF
City of Columbus Ohio 559 Dublin Av	20 WKOR	158.13	MF
Columbus & So Ohio Elec Co 100 Hickory St			
Columbus Ohio	22 WJGK	31.46	GF
N Colum Quad Madison Tn O	WJGN	31.46	GF
E Colum Quad Harrison Tn O	WJGR	31.46	GF
Commonwealth Edison Co			
Mobile	48 WDVY	158.13	MF
US Rt 4 Kewanee Ill	WBHH	39.66	MF
St Ald Rt 10 Pekin Ill	WBHA	39.66	MF
72 W Adams St Chicago Ill	WBYU	39.66	MF
3400 N Calif Av Chicago Ill	WKGO	39.66	MF
US Rt 51 Oglesby Ill	WJMS	39.66	MF
2113 W Thomas St Chicago Ill	WKGR	39.66	MF
3501 S Pulaski Rd Chicago	WKGS	39.66	MF
1111 Cermak Rd Chicago Ill	WKGT	39.66	MF
6141 S Prairie Av Chicago	WKGU	39.66	MF
3200 E 100th St Chicago	WKGV	39.66	MF
Conn Lt & Pr Co Clough Rd			
Waterbury Conn	8 WAWT	39.86	MF
US Rt 7 Milford Conn	WAWK	39.86	MF
Conn St Hwy Rt 31 Stevenson	WAWN	39.86	MF
Montville Conn	WAWY	39.86	MF
Naugatuck Av Devon Conn	WAWF	39.86	MF
250 Freight St Waterbury Conn	WAWV	39.86	MF
Bellevue Av Southington Conn	KVIMC	39.86	MF
Consolidated Edison Co of N Y Inc 4 Irving Pl N Y	2WJHJ	31.74	Wa
Consolidated Edison Co 217 W Jackson St			
Mexico Mo	9 KSHD	37.86	GF
Cons Gas Elec Lt & Pr 501 E Madison			
Baltimore Md	WAOI	39.86	MF
Mobile	WJLB		
Rdout St B & A RR Annapolis	WCPK	39.86	MF
114 S Main St Bel Air Md	WNSM	39.86	MF
Locust & Winters Westminster	WSTP	39.86	MF
Coop Elec Co Pleasant & 4th Sts			
St Ansgar Iowa	3 KRKT	39.66	MF
Corn Belt Elec Coop 315 E Front St			
Bloomington Ill	20 WKNX	37.62	MF
Cumberland Elec Memb Corp			
Springfield Mo	28 WFGH	39.66	MF
Cumberland Dr Clarksville Tn	WJPN	39.66	MF
Dairyland Pr Coop Eagle Point Tn			
Pippewa Falls Wis	8 WDPD	39.66	MF
Baldwin Tn Baldwin Wis	WKWG	39.66	MF
DPC Power Plant Genoa Wis	WKSJ	39.66	MF
Alma Wis	WETV	39.66	MF
Dallas Pr & Lt Co 515 Park Av	1 KJTB	39.98	MF
Dallas Tex			
Denton Pr & Lt Co E River Rd	75 WAMZ	39.86	MF
Denton Okla			
503 N Columbus St Wilmington	WBNH	39.86	MF
101 E St Washington CH Ohio	WBNJ	39.86	MF
215 Sycamore St Xenia Ohio	WBNK	39.86	MF
12 S Main St W Alexandria O	WBNI	39.86	MF
115-117 S Wayne St Dayton O	WOBH	39.86	MF
US Hwy 36 St Plaquemine O	WJPM	39.86	MF
Campbell Rd Sidney Ohio	WJTO	39.86	MF
State Rt 219 Coldwater Ohio	WJTX	39.86	MF
113 S Main St Marysville O	WJTY	39.86	MF
Orchard Rd Rd Russell O	WJTZ	39.86	MF
Delaware Pr & Lt Co SE Read & S Madison Sts	16 WQHT	39.86	GF
Wilmington Del			
Detroit Edison Co 220 E Herill St			
Birmingham Mich	7 WCGZ	39.66	MF
Portable and Mobile	WDEQ	153.59	MF
200 2nd Av Detroit Mich	WDAJ	3.190	GF
600 Gd River Av Pt Huron	WDEP	39.66	MF
308 E Huron St Bad Axe Mich	WGYF	39.66	MF
315 Cedar St Lapeer Mich	WGYH	39.66	MF
19 S Elk St Sandusky Mich	WGYK	39.66	MF
Gratlot Rd Marysville Mich	WMAV	3.190	GF
2000 2nd Av Detroit Mich	WQHL	39.66	MF
Mobile	21 WJRK	39.66	MF
401 S Main St Superior Mich	WROV	39.66	GF
401 S Main St Superior Mich	WSTP	3.190	GF
Dixie Elec Memb Corp			
Baton Rouge La	6 WDWR	37.62	MF
Douglas Co Coop Lt & Pr Assn	3 KRHD	31.46	GF
Alexandria Minn			
Church & Pray Douglasville Ga	WUEX	37.62	GF
Duquesne Lt Co			
Springdale Pa	17 WCHV	31.46	MF
435 6th Av Pittsburgh Pa	WETD	31.46	MF
Brunot Island Pittsburgh Pa	WETD	31.46	MF
435 6th Av Pittsburgh Pa	WETI	31.46	MF
Wireton Pa	WFOI	31.46	MF
W Millin Borough Pa	WQHO	31.46	MF
Rochester Tn Pa	WQHR	31.46	MF
Eastern Iowa Lt & Pr Corp Wash & US Rt 61	10 KOCX	33.34	MF
Wapello Iowa			
5th & Sycamore Wilton Jet Ia	KOFV	33.34	MF
1505 6th Av DeWitt Iowa	KOGV	33.34	MF
Egyptian Elec Coop Intersect Hwy 3 & Mo	23 WCVH	37.62	GF
Steeleville Ill			
N Ill Av Carbondale Ill	WCVN	37.62	GF
Empire Dist Elec Co Church & Elm Sts			
Aurora Mo	45 KCKJ	39.66	GF
925 E 4th St Joplin Mo	KFLC	39.66	GF
141 N Main St Gravette Ark	KTNW	39.66	GF
Nichols St Springfield Mo	KVTF	39.66	GF
Pierre City Mo	KWQJ	39.66	GF

PUBLIC UTILITIES — Continued

Florida Pr Corp 16th St Sub-sta	66	WJTL	31.46	Mf
St Petersburg Fla	130	WJTR	31.46	Mf
331 13th Av So St Petersburg				
Fla Pr & Lt Co Orange Av & 18th				
Sarasota Fla				
Charlotte Av W Palm Rch Fla				
314 SW 1st St Miami Fla				
Greenleaf & Twigg Palatka Fla				
Broward Rd Ft Lauderdale Fla				
Nesbitt St Punta Gorda Fla				
Factory St Cocoa Fla				
Seagrave St Ft Pierce Fla				
Orange Av Ft Pierce Fla				
318 NW 3rd Av Ft Lauderdale				
8 Bacon Pt Rd Pahokee Fla				
Hotel Annie Macelenny Fla				
178 Hwy 17 Lk Monroe Fla				
118 Ribera St Augustine				
9th St & W 2nd Hialeah Fla				
523 NW 11th St Miami Fla				
St Clair St Lake City Fla				
2010 Lee St Ft Myers Fla				
Fontana Union Water Co 160 E Spring				
Fontana Calif				
Forked Deer Elec Coop Inc 111 S Front				
Halla Tenn				
Freeborn-Mower Coop Lt & Pr Assn 437 Bridge				
Albert Lea Minn				
Fulton City Ru Elec Mem Corp 513 Main St				
Rochester Ind				
Georgia Power Co Tallulah Falls				
Tallulah Falls Ga				
409 Oak St Gainesville Ga				
Ga Pr Substation Lindale Ga				
849 Main St Thomson Ga				
15th & Greene Sts Augusta Ga				
1801 N Blvd NE Atlanta Ga				
1004 Blvd Athens Ga				
Gibson City Elec Mem Corp Bway				
Obion Tenn				
Hwy 45 W Trenton Tenn				
Godfrey L Cabot Inc Bradley Comp Sta				
Brier Cr Balleysville Wva				
Pinetown Wva				
224 1/2 Main St Beckley Wva				
723 Kanawha Blvd Charleston				
Grand River Dam Authority				
Langley Okla				
Pryor Okla				
RR 10 Box 135 Tulsa Okla				
Grand Valley Ru Pr Lines 120 N 7th St				
Grand Junction Colo				
Grant Elec Coop 103 N Madison				
Lancaster Wis				
Guernsey Muskingum Elec 27 E Main St				
New Concord Ohio				
Gulf Pr Co Hartford Ave				
Panama City Fla				
Jackson St Pensacola Fla				
Gulf Sts Utilities Co 1563 Govt St				
Baton Rouge La				
GSU Office Bldg Navesota Tex				
15th St & Av 1 Hinds Navesota Tex				
129 S Chambers Conroe Tex				
Main St Calvert Tex				
GSU CO Sub Lafayette La				
336 1/2 Liberty Beaumont Tex				
Houston Av Pt Arthur Tex				
Front & 1st Sts Pt Arthur Tex				
Neeches Pr Pl Beaumont Tex				
Hancock-Wood Elec Coop Inc				
N Baltimore Ohio				
Harrison City Ru Elec Coop Corp				
Cynthiana Ky				
Hart City Elec Mem Corp Depot & Carolina Sts				
Hartwell Ga				
Hartford Elec Lt Co 268 Pearl St				
Hartford Conn				
Henderson-Union Ru Elec Coop Corp US Hwy 41 & 60				
Henderson Ky				
Hickman-Fulton Ru Elec Coop Corp 230 S Clinton				
Hickman Ky				
Hill City Elec Corp 212 Main St				
Itasca Tex				
Holston Elec Coop 108 S Church St				
Rozersville Tenn				
Holyoke Water Pr Co Water St				
Holyoke Mass				
Home Gas & Elec Co 810 9th St				
Greeley Colo				
Hope Natural Gas Co				
Chelvan Wva				
Marianna Wva				
Nr Corton Wva				
445 W Main St Clarksburg Wva				
Kopperston Wva				
Houston Ltine & Pr Co 2114 Church St				
Galveston Tex				
644 5th St Rosenberg Tex				
214 W Park Freeport Tex				
301 Texas Goose Creek Tex				
1016 Walker St Goose Cr Tex				
6200 Canal St Houston Tex				
Substa LaMarque Tex				
4200 Richmond Rd Bellaire Tex				
Elec Bldg Houston Tex				
Huntington City Ru Elec Mem Corp 419 Poplar				
Huntington Ind				
Idaho Pr Co 621 So 17th St				
Boise Idaho				
Ill Elec & Gas Co 111 N 16th St				
Herrin Ill				
Gas Pl Du Quoin Ill				
1015 Chestnut St Murphysboro				
St Rt 37 Marlon Ill				
Ind & Mich Elec Co RR 2 Leo Rd				
Allen City Ind				
159 W Main St Benton Harbor				
110 W Lex Av Elkhart Ind				
Twin Br Pr Pl Mishawaka Ind				
401 E Colfax Av So Bend Ind				
112 Days Av So Bend Ind				
600 E Water Montpelier Ind				
N A & 14th Sts Elwood Ind				
238 S Bway Butler Ind				
419 N Walnut Muncie Ind				
120 Branson Marlon Ind				
Indiana Service Corp Horton & Johnson Sts				
Bluffton Ind				
1704 S Webster St Ft Wayne				
2101 Spy Run Av Ft Wayne Ind				
Indianapolis P & L Co 1230 W Norris St				
Indianapolis Ind				
Inter-City Ru Elec Coop Inc 135 S High St				
Hillsboro Ohio				
102 S Walnut Chillicothe O				
Interstate Power Co Service Bldg E of 8th St				
Dubuque Iowa				

Iowa Elec Lt & Pr Co 213 2nd St NE				
Cedar Rapids Iowa				
803 Main Adel Iowa				
1105 Main Knoxville Ia				
S Walnut St Colfax Ia				
118 SE 5th St Des Moines Ia				
1st Av & A St Oskaloosa Ia				
15th Clarinda Ia				
Chestnut St Avoca Iowa				
Sheridan St Shenandoah Ia				
2nd Av & 5th Malvern Ia				
Iroquois Gas Corp 249 W Genesee St				
Buffalo NY				
338 Bailey Av Buffalo NY				
301 Union St Hamburg NY				
Disp Sta Gowanda Village NY				
38 Main St Salamanca NY				
Jackson City Ru Elec Mem Corp 101 W Walnut				
Brownstown Ind				
City of Jacksonville Fla 1050 Laura St				
Jacksonville Fla				
Jefferson Davis Elec Coop Inc Peterson Bldg				
Jennings La				
Jersey Centr Pr & Lt Co 521-5 Main St				
Allenhurst NJ				
Jump River Elec Coop Inc Vosz Bldg				
Ladysmith Wis				
Kankakee Valley REMC				
Wanatah Ind				
Kansas City Pr & Lt Co 117 S Miller St				
Sweet Springs Mo				
Mobile				
Jackson & Bway Brunswick Mo				
24th & Main Hixsonville Mo				
410 S Main St Ottawa Kan				
1330 Baltimore Av Kans City M				
Kansas G & E Co 1900 E Grand Av				
Whelita Kan				
Portland Ore				
900 N 2nd Independence Kan				
Kans-Neb Natural Gas Co 300 N St Joseph St				
Hastings Neb				
Scott City Kan				
332 State St Phillipsburg Kan				
20th & Main Kan				
Palco Kan				
Deerfield Kan				
Holdrege Neb				
Ottis Kan				
Kay Elec Coop Inc 201 E				
Tulane La				
Ky Wva Pr Co Inc				
Lothar Ky				
Ky Utilities Co Limestone & Short Sts				
Lexington Ky				
City of Knoxville Tenn Wash & 6th Av				
Knoxville Tenn				
Rural Elec Assn Inc 117 Cour d'Alene				
Coeur d'Alene Idaho				
City of LaFollette Tenn 102 E Central				
LaFollette Tenn				
City of Lamar Colo 106 W Elm St				
Lamar Colo				
Lamar City Ind				
Paris Tex				
Lawrence G&E Co 173 Methuen St				
Lawrence Mass				
Lincoln El Coop Inc 10th & Jefferson				
Davenport Wash				
Linn City Ru El Coop Assn 1138 7th Av				
Marian Iowa				
The Little Oenulgee El Mem Corp 323 Rr Av				
Alamo Ga				
Little Rock Ark Mun Wtr Wks Mun Filter Pl				
Little Rock Ark				
Salina Ark				
L Lighting Co Woodbine Av				
Northport NY				
Grove St Glenwood Landing NY				
River Rd Riverhead NY				
90 E Main St Bay Shore NY				
Power House Rd Roslyn NY				
Lorain-Medina Ru El Coop 224 N Main				
Wellington Ohio				
City of Los Angeles Calif 246 W Market				
Independence Calif				
316 W 2nd St Los Angeles				
207 S Bway Los Angeles				
Victorville Calif				
Silver Lk Camp Calif				
600 Nevada Hwy Bldr City Nev KIKH				
Louisiana Power & Lt Co Monroe & Kepler				
Gretna La				
Highway 51 Amite La				
433 Metairie Rd Metairie La				
Main St Hammond La				
Main St Ponchatoula La				
Main St Lockport La				
Miss St Donaldsonville				
Hwy 80 & 16 Delhi La				
613 N Front Olla La				
500-2 E Green Tallulah La				
514 2nd St Ferriday La				
703 S 1st St Gibsland La				
225 F Jefferson Gibsland La				
Louisville G&E Co 731 Ormsby St				
Louisville Ky				
Lower Colo River El Coop				
Childs Tenn				
College Wtr Tnk San Marcos				
Marshall Ford Dam, Tex				
Peters Tex				
Lynn Gas & El Co 788 Broad St				
Lynn Mass				
Lyntgar El Coop Inc City Wtr Twr				
Tahoka Tex				
Macon El Coop Martin Bldg				
Macon Mo				
Magic Valley El Coop Inc 638 S Tex Av				
Mercedez Tex				
Mobile				
Magnolia El Pr Assn 213 Canal St				
McComb Miss				
City of Marshfield Wis 112 E 2nd St				
Marshfield Wis				
McLeod Coop Pr Assn 808 Franklin St				
Glencoe Minn				
City of Memphis Tenn 179 Madison Av				
Memphis Tenn				
Met Edison Co 141 S 7th St				
Reading Pa				
Michigan Consol Gas Co				
Freeman Tn Mich				
Austin Tn Mich				
Middle Tenn El Mem Corp				
Franklin Tenn				
220 E Main Lebanon Tenn				
225 N Walnut St Murfreesboro				
Midwest El Co E Spring St				
St Marys Ohio				
Greenlawn Av Elda Ohio				

Mid-Yellowstone El Coop Inc				
Hysham Montana	4	KSRK	37.70	Gr
Minneapolis Gas Lt Co 700 Linden Av				
Minneapolis Minn	43	KIDJ	31.46	Gr
Minnkota Pr Coop Inc US Highway 81	20	KUKC	37.82	At
Harrods Fork Miss				
Grand Forks N D		KUGK	37.66	At
Minnesota Pr & Lt Co 30 W Superior St				
Duluth Minn	30	KSII	37.54	Gr
Mississippi Pr Co 327 Delmas Av				
Pascagoula Miss	30	WKMS	158.13	Mf
Hwy 49 Gulfport Miss		WKMQ	158.13	Mf
Legion Bldg Poplarville Miss		WGRQ	158.13	Mf
721 Main Columbia Miss		WGSQ	158.13	Mf
Waynesboro Miss		WGSU	158.13	Mf
Mississippi Pr & Lt Co 414 S Commerce				
Jackson Miss	10	WAPG	39.86	Lf
Modesto Irrigation Dist Ensen Av				
Modesto Calif		KQBZ	2.726	Ca
Mobile	13	KQCV	31.74	Ca
Monongahela Pr Co 314 Jefferson St				
Fairmont W Va	5	WJBQ	37.18	Lf
5th & RR Elkins W Va		WJBU	37.18	Lf
Substation Howesville W Va		WJBX	37.18	Lf
Ct Sq Webster Spvs W Va		WJBZ	37.18	Lf
Montana Pr Co Higgins & Bank				
Missoula Mont		KOBI	158.13	Mf
Montant Pr Co				
Cut Bank Mont	16	KOBQ	158.13	Mf
Morgan County Rural El Mem Corp 159 Main				
Martinsville Ind	5	WEPG	39.66	Mf
Mountain Fuel Supply Co 615 Conn Av				
Rock Springs Wyo	1	KAYG	2.726	Wa
Coalville Utah		KQVK	2.726	Wa
Narragansett Elec Co 280 Melrose St				
Providence RI	45	WMVW	39.66	Gr
New Bedford Gas & Edison Lt Co 5 Cannon St				
New Bedford Mass	12	WHUA	39.66	Lf
Carver Rd Watham Mass		WHUD	39.66	Lf
NE Power Co Grafton St				
Milbury Mass		WAQJ	2.726	Ga
45 Conway St Buckland Mass		WAOK	2.726	Ga
NJ Power & Lt Co				
Phillipsburg NJ	200	WURC	75.50	Lf
105 E McFarlan Dover NJ		WURD	75.50	Lf
217 Spring St Newton NJ		WURE	75.50	Lf
38 Main St Flemington NJ		WURF	75.50	Lf
179 Main St Hackettstown NJ		WURL	75.50	Lf
New Orleans Pub Ser Inc 527 Magnolia St				
New Orleans La	35	WXPY	158.13	Mf
274 Tulane Av New Orleans La		WYOM	31.46	Mf
Market St New Orleans La		WYOL	39.66	Mf
Dwyer Rd New Orleans La		WYWD	153.59	Mf
3734 Tulane New Orleans La		WYWE	153.59	Mf
Valence St New Orleans La		WYWG	153.59	Mf
Polymnia St New Orleans La		WYWH	153.59	Mf
Byrads St New Orleans La		WYWI	153.59	Mf
Iberville St New Orleans La		WYWO	153.59	Mf
Elysian Flds New Orleans		WYXO	153.59	Mf
NY State Elec & Gas Corp 15 Eldridge St				
Binghamton NY	8	WPIH	31.98	Lf
NY State Natural Gas Co				
St Genesee Pa	14	WBKK	37.86	Lf
168 S Main St Wellsville NY		WBKJ	31.86	Lf
Caledonia NY		WBKU	37.86	Lf
Otisco NY		WKOF	37.86	Lf
Lawrence Tn Pa		WKRJ	37.86	Lf
Taylor Farm Waynesburg Pa		WSTZ	37.86	Lf
Noble City Ru Elec Mem Corp				
Albion Ind	5	WNZF	37.54	Mf
No Indiana Pub Ser Co W Wash St				
Goshen Ind	96	WDHV	39.86	Mf
Wash St Valparaiso Ind		WIKF	39.86	Mf
701 Wash St LaPorte Ind		WKYO	39.86	Mf
Angola Ind Substation		WMRH	39.86	Mf
340 N Buffalo Warsaw Ind		WMRQ	39.86	Mf
Lake Av Plymouth Ind		WMRM	39.86	Mf
Hanswatt St Monticello Ind		WSRA	39.86	Mf
W 108 Goss Kentland Ind		WSRB	39.86	Mf
8th St Fowler Ind		WSRG	39.86	Mf
4621 Elm Av Hammond Ind		WUDK	39.86	Gr
Northern Natural Gas Co				
Oxford Iowa	190	KAXG	33.18	f
Peullina Iowa		KAXI	33.18	f
Welcome Minn		KCFR	33.18	f
Beaver Okla		KTOP	33.18	Mf
Skellytown Tex		KTPQZ	33.18	Mf
So Sioux City Nebr		KWSR	33.18	f
Hooper Nebr		KZRC	33.18	f
82 S V Buren Hugoton Kan		KXWT	33.18	Mf
Sublette Kan		KYDH	33.18	f
Millville Kan		KYDI	33.18	f
Bushton Kan		KYDL	33.18	f
Clifton Kan		KYDS	33.18	f
Beatrice Nebr		KYDO	33.18	f
Palmyra Nebr		KYDR	33.18	f
Oakland Iowa		KYDT	33.18	f
Minneapolis Minn		KYGL	33.18	f
Omaha Nebr		KTVX	33.18	Mf
Ventura Iowa				
Northern Piedmont El Coop 175 E 17th St				
Culpeper Va	5	WGDO	153.59	a
Northern States Power Co				
St Croix Falls Wis		WPL	3.190	Ca
15 S 5th Minneapolis Minn		WLP	3.190	Ca
Nueces El Coop Inc 526 Main				
Robstown Tex	4	KBMM	39.86	Gr
Oakdale Iowa El Assn US Hwy 12-16				
Oakdale Wis	5	WNPE	39.86	Mf
Ohio Edison Co 325 E North St				
Akron Ohio	46	WOFA	39.86	Lf
125 E Boardman St Youngstown		WOFM	31.46	Lf
21 E High Springfield O		WQRP	39.66	Lf
Biggs Grove Ohio		WNTQ	33.34	Lf
Ohio Fuel Gas Co So Pt Comp Station				
S Point Ohio	25	WXPY	33.34	Lf
Ohio-Midland Lt & Pr Co 10 S High St				
Canal Winchester Ohio	6	WEUX	37.54	Mf
Ohio Power Co. St Rt 214				
Bellaire Ohio	221	WAHO	39.86	Lf
Portable	4	WOIW	2.726	Ma
St Rt 61 Vernon Jet Ohio		WAFJ	39.86	Lf
Walnut St Kenton Ohio		WAGS	39.86	Lf
North St Zanesville Ohio		WAJN	39.86	Lf
W Main St Crooksville O		WAGB	39.86	Mf
Sunnyside Sub Waco O		WCGF	39.86	Lf
216 N 5th St Lima O		WCIL	39.86	Lf
111 N Wash St Van Wert O		WCLS	39.86	Mf
Defiance St Lepsle O		WCRE	39.86	Mf
45 N Monroe Tiffin O		WDRN	39.86	Lf
132 Kv Sub Newcomerstown O		WDRK	39.86	Lf
65 E Main Newark O		WAMZ	39.86	Lf
2 E High Hickman O		WOPG	39.86	Mf
120 N 4th St Boscoe O		WOIM	39.86	Lf
Ohio Pub Serv Co Oyster Rd				
Bluebell Substa Alliance O		WAHI	39.66	Lf
128 E Liberty Vermillion O		WEHM	39.66	Lf
Hardy City Ark Marion O		WBJW	39.66	Lf
200 Oberlin Av Lorain O		WITY	39.66	La
Middle Rowsburg Rd Ashland O		WJPH	39.66	Lf
Harkness St Bellevue O		WKBJ	39.66	Lf
W Main St Loudonville O		WKPO	39.66	Lf

PUBLIC UTILITIES — Continued

19 N Main Rittman O	WKVU	39.66	Lf	Marion City Ind	WKKI	31.46	Lf	Southern Ill El Coop Illinois Rt 145	WSFN	37.70	Gf	
150 S Olive St Ellyria O	WMLX	39.66	Lf	Dresser Pr Sta Terre Haute	WNVA	37.82	Lf	Metropolis Ill	WSFO	37.70	Gf	
8 Main Ext Warren O	WMLX	39.66	Lf	Public Serv Co of NH 1087 Elm St	WENA	158.25	Mf	200 Charles St Dongola Ill	WSFO	37.70	Gf	
Harber Rd Pt Clinton O	WMLY	39.66	Lf	Manchester NH	WGNF	39.86	Gf	Southern Natural Gas Co Montgomery Hwy	WBVO	39.66	Mf	
9th St Massillon O	WROW	39.66	Lf	600 S Main St Tulsa Okla	WGNF	39.86	Gf	Wetumpka Ala	WBVO	39.66	Mf	
Olivensburg Rd Mansfield O	WQWX	39.66	Lf	Public Serv Co of Okla	WCHC	37.18	Lf	2008 3rd Ave N Birmingham Al	WKHT	39.66	Mf	
Perkins Av Sandusky O	WQWX	39.66	Lf	1 Newman S Hackensack NJ	KRPG	39.86	Gf	Sewell Rd Atlanta Ga	WKHT	39.66	Mf	
City of Okla-Water Dept	WRRR	39.66	Lf	Mobile	WCHC	37.18	Lf	RFD 1 Perryville Ala	WQVY	39.66	Mf	
Pump Station	KSNX	—	—	900 W Grand S Elizabeth NJ	WCIA	37.18	Lf	Holton Rd Macon Ga	WWNA	39.66	Mf	
Filter Plant	KSNY	—	—	Pub Serv & Gas Co 31 Van Houten St	WCIA	37.18	Lf	Southside El Coop Inc Rt 460	WBUP	37.78	Lf	
Okla Gas & Elec Co 301 S Cherokee St	KSMO	39.66	Lf	Paterson NJ	WCID	37.18	Lf	Crewe Va	WBUP	37.78	Lf	
Muskogee Okla	KENA	3.190	Ca	225 N Warren St Trenton NJ	WCID	37.18	Lf	Rt 460 Crewe Va	WBUP	37.78	Lf	
4th St Ead Okla	KENA	3.190	Ca	17th St Camden NJ	WCID	37.18	Lf	Southwestern Nat Ru El Coop Corp 21 N 5th	WBUP	37.78	Lf	
Kelley St Ft Smith Ark	KENS	3.190	Ca	938 Clinton Av Irvington NJ	WCID	37.18	Lf	Indiana Pa	WBUP	37.78	Lf	
301 S Cherokee Muskogee Okl	KENS	3.190	Ca	Princeton NJ	WEPI	—	—	Southwest La El Mem Corp 203 N College Av	WBUP	37.78	Lf	
2500 Midland Ft Smith Ark	KQMO	39.66	Lf	268 Baldwin Jersey C NJ	WMQV	37.18	Lf	5 KBYF	33.58	Gf		
Harrah Okl Generating Plt	KRMI	39.66	Lf	268 Baldwin Jersey C NJ	WNPF	37.18	Lf	Longview Tex	19 KAKU	39.86	Gf	
Owen City Ru El Coop Corp Court St	SR	—	—	Pub Utl Dist 1-Lewis City Wash	981 Pacific	39.66	Rf	Southwestern Pub Serv Co 2nd & Fillmore	57 KPOZ	31.46	Gf	
Owenton Ky	12 WRFJ	37.62	Gf	Chellie Wash	4 KAAU	39.66	Rf	417 E 6th Borker Tex	KCTQ	31.46	Mf	
Ozarks Ru El Coop Corp 17 N Block St	10 KCLM	39.98	Mf	Morton Wash	7 KAAU	39.66	Rf	1005 Av K Lubbeck Tex	KCTS	31.46	Gf	
Fayetteville Ark	10 KCLM	39.98	Mf	Pub Utl Dist 1-Clark City Wash	814 Wash St	153.59	Mf	Tuco Gen Sta Abernathy Tex	KQHC	31.46	Gf	
Northwestern Elec Co E Lewis & Lorling	38 KPPH	39.86	Mf	Vancouver Wash	40 KACH	153.59	Mf	Stearns El Assn	6 KSLV	30.86	Gf	
Portland Ore	3 KAGN	35.14	Ca	Pub Utl Dist 1-Cowittz City Wash	Longview Wash	37.66	Gf	Melrose Minn	4 KCVQ	39.86	Gf	
Portland Ore	3 KAGN	35.14	Ca	PR Water Res Authority Santurce PR	PR Pl	39.66	Mf	Stevens City El Coop Inc 344 N Main St	4 KCVQ	39.86	Gf	
Pacific Pr & Lt Co 6th & Rose	24 KSNX	153.59	Mf	San Juan Pr	17 WENT	39.66	Mf	Colville Wash	4 KCVQ	39.86	Gf	
Walla Walla Wash	KTLU	153.59	Mf	Mobile	10 WTLG	39.66	Mf	Suburban Natural Gas Corp 400 E 8th St	30 KSNX	158.25	Mf	
Union Gap Wash	KTLU	153.59	Mf	Hostos Av Ponce PR	KAOI	2.726	Ca	Dewey Okla	30 KSNX	158.25	Mf	
Panhandle Eastern Pipe Line Co 307 Kansas	206 KFOH	39.86	Mf	Guayama PR	WAJU	2.726	Ca	Sumter El Coop Inc	8 WSTW	33.26	Gf	
Lheral Kan	KFOH	39.86	Mf	Mayaguez PR	KAWY	2.726	Ca	Sumter El Coop Inc	8 WSTW	33.26	Gf	
Oppe Kan	KFOH	39.86	Mf	Puket Snd Pr & Lt Co 7th Av & Olive St	WQIL	2.726	Ca	City of Tacoma Wash Tideltats Sub	60 KBOJ	158.25	Mf	
Shuray Tex	KIUG	39.86	Mf	Seattle Wash	55 KNIO	75.42	Lf	1171 E Taylor Way Tacoma	KBOJ	158.25	Mf	
Houstonia Mo	KLAI	39.86	Mf	Queens Borough G&E Co Brunsweck Av	9 WRDI	39.86	Lf	Alder Pwr Hs Alder Wash	KHCD	158.25	Mf	
Louisburg Kan	KLAY	39.86	Mf	Far Rockaway NY	WRDI	39.86	Lf	LaGrande Wash	KHCD	158.25	Mf	
Hoonville Mo	KPHD	39.86	Mf	Rochester Elec Dept	WRDI	39.86	Lf	Podlatch Wash	KHCD	158.25	Mf	
1221 Baltimore Av Kan City Mo	KPHD	39.86	Mf	Rochester Minn	KNIP	—	—	Tallahatchie Valley El Pr Assn REA Office	12 WKKP	33.34	Gf	
Arkaton Kan	KPHD	39.86	Mf	City of Rochester El Dept	KNIP	—	—	Batesville Miss	12 WKKP	33.34	Gf	
Centralia Mo	KPHD	39.86	Mf	Rochester Minn Mobile	KNIP	—	—	Tampa Elec Co Pwr Plt Parker St	WTWC	153.59	Mf	
Greensburg Kan	KPHD	39.86	Mf	Rochester G&E Corp 174 Front St	KNIP	—	—	Tampa Elec Co Ice Plant Bide E Haines	50 WTWL	153.59	Mf	
Dumas Tex	KPHD	39.86	Mf	Rochester N York	WGAE	39.86	Gf	Plant City Fla	50 WTWL	153.59	Mf	
Hardesty Tex	KPHD	39.86	Mf	Rockland Lt & Pr Co Bway & Ivy Sts	8 WCWP	31.46	Mf	Winter Haven Fla	WTWL	153.59	Mf	
Haven Kan	KPHD	39.86	Mf	Central Nyack NY	8 WCWP	31.46	Mf	Seaboard RR Mulberry Fla	WTWL	153.59	Mf	
Hugoton Kan	KPHD	39.86	Mf	48 Gentung St Middleton NY	WCWP	31.46	Mf	11th Av Substa Tampa Fla	WTWL	153.59	Mf	
Natanta Kan	KPHD	39.86	Mf	Roosevelt City Elec Coop Inc 202 SE Main	Portales NMEX	37.70	Mf	Taylor El Coop Inc 304 Front St	KKLW	37.62	Mf	
451 E Prospect Jackson Mich	WPHW	39.86	Mf	Portales NMEX	10 KNID	37.70	Mf	Merkel Tex	KKLW	37.62	Mf	
Montezuma Ind	WPHW	39.86	Mf	Roadway Gas Co 2700 Shirley Memorial Hwy	5 WRKA	33.06	Lf	Mobile Minn	KKLW	37.62	Mf	
Pleasant Hill Ill	WPHW	39.86	Mf	Arlington Va	5 WRKA	33.06	Lf	Texas El Serv Co 6th & Calhoun Sts	10 KTES	39.66	Gf	
Edgerton Ind	WPHW	39.86	Mf	Rural Coop Pr Assn	12 KGNX	33.34	Mf	Et Worth Tex	10 KTES	39.66	Gf	
Clenarm Ill	WPHW	39.86	Mf	Pine City Minn	12 KGNX	33.34	Mf	Burnett St Wlehta Falls Tx	KUKR	39.66	Gf	
Tuscola Ill	WPHW	39.86	Mf	Milaca Minn	KGNT	33.34	Mf	Texas Pr & Lt Co 1001 W Erwin St	8 KRZL	33.02	Gf	
Zionsville Ind	WPHW	39.86	Mf	REA Pl Hawick Minn	KGNT	33.34	Mf	Tyler Tex	8 KRZL	33.02	Gf	
Indiana Rd Maumee Ohio	WQGF	39.86	Mf	REA Pl Cambridge Minn	KQWZ	33.34	Mf	Gainesville Tex	KRNX	—	—	
WQGF	39.86	Mf		Rush City Ru El Mem Coop 119 East 3rd St	3 WDHG	31.46	Lf	Sherman Tex	KRNX	—	—	
WQGF	39.86	Mf		Rushville Ind	3 WDHG	31.46	Lf	El Gen Sta Palestine Tex	KRZO	33.02	Gf	
WQGF	39.86	Mf		Rutherford El Mem Corp 1 Main St	7 WSNY	37.78	Gf	El substa Athens Tex	KRZO	33.02	Gf	
WQGF	39.86	Mf		Forest City NC	7 WSNY	37.78	Gf	Gen sta Trinidad Tex	KRZR	33.02	Gf	
WQGF	39.86	Mf		Sacramento Utl Dist Calif 20th St	9 KHPR	153.59	Mf	Tipmont Ru El Mem Corp Linden St Bnk Bldg	7 WQTH	39.66	Gf	
WQGF	39.86	Mf		Sacramento Calif	9 KHPR	153.59	Mf	City of Toledo Ohio Intake Crb	WBVO	31.46	Gf	
WQGF	39.86	Mf		Safe Harbor Wtr Pr Corp Safe Harbor Pr Hs	5 WNFJ	30.86	Lf	Toledo Ohio	WBVO	31.46	Gf	
WQGF	39.86	Mf		Manor Tn Pa	5 WNFJ	30.86	Lf	Low Ser Pump Sta Toledo O	WBVO	31.46	Gf	
WQGF	39.86	Mf		St Joseph Lt & Pr Co	5 WNFJ	30.86	Lf	Collins Plk Toledo Ohio	WBVO	31.46	Gf	
WQGF	39.86	Mf		St Joseph Mo	5 WNFJ	30.86	Lf	Toledo Edison Co 1001 W Delaware St	WBVO	31.46	Gf	
WQGF	39.86	Mf		City of St Petersburg Fla Mirror Lk Drive	3 WPOB	39.86	Mf	Toledo Ohio	WBVO	31.46	Gf	
WQGF	39.86	Mf		St Petersburg Fla	3 WPOB	39.86	Mf	134 S 5th St Fremont Ohio	WQJO	39.86	Gf	
WQGF	39.86	Mf		City of San Antonio Tex 201 Mission Rd	73 KANX	31.46	Gf	Power Dam Rd DeFiance Ohio	WQJO	39.86	Gf	
WQGF	39.86	Mf		San Antonio Tex	73 KANX	31.46	Gf	134 N Fulton St Wauseon O	WQJO	39.86	Gf	
WQGF	39.86	Mf		326 Jones Av San Antonio Tx	KRMW	31.46	Gf	Trompeau Elec Coop 702 E Main	4 WBZM	39.66	Mf	
WQGF	39.86	Mf		San Diego G&E Co 114 10th Av	43 KROA	41.46	Gf	Tri-City Elec Mem Corp Walnut St	12 WAXD	75.50	Lf	
WQGF	39.86	Mf		San Diego Calif	43 KROA	41.46	Gf	Lafayette Tenn	12 WAXD	75.50	Lf	
WQGF	39.86	Mf		311 N Tremont Oceanalide Cal	KSKL	153.71	Gf	1st St Tompkinsville Ky	WAXN	75.50	Lf	
WQGF	39.86	Mf		San Patricio El Coop Inc	8 KSKL	39.98	Gf	215 E Main Scottsville Ky	WAXN	75.50	Lf	
WQGF	39.86	Mf		Shinton Tex	8 KSKL	39.98	Gf	Tri-City Elec Coop Mich	5 WSCZ	31.46	Gf	
WQGF	39.86	Mf		Satilla El Mem Corp PO Box 11	8 WOLF	39.70	Gf	Westbury Mich	7 KHFU	39.66	Mf	
WQGF	39.86	Mf		Alma La	8 WOLF	39.70	Gf	Gr River Av Portland Mich	WKNH	31.46	Gf	
WQGF	39.86	Mf		Scott-San Madrid-Miss El Coop 18 Hwy 60	15 KOVE	37.62	Gf	City of Tulsa Okla Water Dept Office	15 KNHN	37.86	Mf	
WQGF	39.86	Mf		Sikeston Mo	15 KOVE	37.62	Gf	Spavinaw Okla	15 KNHN	37.86	Mf	
WQGF	39.86	Mf		Seranton El Co Seranton El Bldg	20 WGEE	33.26	Mf	405 E 4th Tulsa Okla	KNHR	37.86	Mf	
WQGF	39.86	Mf		Seranton Pa	20 WGEE	33.26	Mf	Uncolnshire Valley Wtr Users' Assn	KGDN	2.292	a	
WQGF	39.86	Mf		City of Seattle Wash 7th & Yesler Sts	58 KKEC	39.66	Mf	Taylor Pk Dam Colo	KGDN	2.292	a	
WQGF	39.86	Mf		Seattle Wash	58 KKEC	39.66	Mf	601 N Park Av Montrose Colo	KGDN	2.292	a	
WQGF	39.86	Mf		Diallo Wash Pr Hs	KFEJ	39.66	Mf	Union El Pwr Co 315 N 12th St	55 KUEC	39.66	Gf	
WQGF	39.86	Mf		Gorge Pr Hs Newhalem Wash	KFEJ	39.66	Mf	St Louis Mo	55 KUEC	39.66	Gf	
WQGF	39.86	Mf		Pr Hs Cedar Falls Wash	KFEJ	39.66	Mf	Union Gas System Inc 1513 W Maple St	41 KBYO	39.86	Mf	
WQGF	39.86	Mf		Rt 1 Bothell Wash	KRTB	39.66	Mf	Independence Kan	41 KBYO	39.86	Mf	
WQGF	39.86	Mf		C Lt Pat Res Hazel Wash	KRTB	39.66	Mf	United Illuminating Co 80 Temple St	26 WBXW	39.66	Lf	
WQGF	39.86	Mf		C Lt Pat Res Rockport Wash	KRTB	39.66	Mf	New Haven Conn	165 E Main St Bridgeport C	WBXW	39.66	Lf
WQGF	39.86	Mf		7th & Yesler Seattle Wash	KRMH	39.66	Mf	165 E Main St Bridgeport C	WBXW	39.66	Lf	
WQGF	39.86	Mf		Ross Dam Wash	KRMH	39.66	Mf	United Natural Gas Co	25 WITB	33.02	Lf	
WQGF	39.86	Mf		Shelby Ru El Coop Corp 2nd & Clay Sts	12 WSDV	37.62	Gf	Lewis Run Pa	25 WITB	33.02	Lf	
WQGF	39.86	Mf		Shelbyville Ky	12 WSDV	37.62	Gf	338 Bailey Av Buffalo NY	WITO	33.02	Lf	
WQGF	39.86	Mf		Singing River El Pr Assn	10 WAXR	33.34	f	Raymont Pa	WITO	33.02	Lf	
WQGF	39.86	Mf		Sloux Valley Empire El Assn Inc	10 WAXR	33.34	f	Sigel Pa	WITO	33.02	Lf	
WQGF	39.86	Mf		Coleman S Dak	KNAX	—	—	Halsey Pa	WITU	33.02	Lf	
WQGF	39.86	Mf		S Atlantic Gas Co 656 E Broughton St	50 KFPW	153.59	Mf	308 Seneca Oil City Pa	WITU	33.02	Lf	
WQGF	39.86	Mf		Savannah Ga	50 KFPW	153.59	Mf	Upper Cumberland El Mem Coop 113 S College	20 WFGY	75.66	Lf	
WQGF	39.86	Mf		S Carolina El & Gas Co W Bridge St	WBCB	31.46	Mf	Carthage Tenn	20 WFGY	75.66	Lf	
WQGF	39.86	Mf		St Matthews S Carolina	4 WBCN	31.46	Mf	117 S Church Livingston Tn	WFGY	75.66	Lf	
WQGF	39.86	Mf		S Carolina El & Gas Co RR Ave	WBCB	31.46	Mf	Utilities Dist of Western Ind REA Office	5 WTAU	39.66	Gf	
WQGF	39.86	Mf		Batesburg SC	4 WBCN	31.46	Mf	37 S Franklin Bloomfld Ind	5 WTAU	39.66	Gf	
WQGF	39.86	Mf		Parr Sheals SC	WBCY	31.46	Mf	Vernon Elec Coop State St	8 WWCV	39.66	Mf	
WQGF	39.86	Mf		301 Gervals Columbia SC	WQGH	31.46	Mf	Virginia Gas Transmission Corp	WOAG	—	—	
WQGF	39.86	Mf		S Carolina Pr Co 141 Neeling St	26 WKPV	39.66	Mf	Standardville Va	WOAH	—	—	
WQGF	39.86	Mf		S Central Ru El Coop Inc 160 W Main St	14 WEVB	37.54	Mf	Mobile	WOAH	—	—	
WQGF	39.86	Mf		Lancaster Ohio	14 WEVB	37.54	Mf	Wash Elec Coop Inc 185 Front St	10 WULJ	37.54	Mf	
WQGF	39.86	Mf		SE Colo Power Assn Inc 19 W 4th St	15 KQAY	37.62	Gf	Marietta Ohio	10 WULJ	37.54	Mf	
WQGF	39.86	Mf		La Junta Colo	15 KQAY	37.62	Gf	Wash Gas Lt Co 25th & H Sts NW	14 WGLL	33.06	Lf	
WQGF	39.86	Mf		1st & Wash Sts Lamar Colo	KQWZ	37.62	Gf	12th & N Sts SE Wash DC	WGLY	33.06	Lf	
WQGF	39.86	Mf		Springfield Colo	KQWZ	37.62	Gf	1100 29th St NW Wash DC	WGLY	33.06	Lf	
WQGF	39.86	Mf		14th St Eads Colo	KQWZ	37.62	Gf	Chillum Rd Chillum Md	WGLY	33.06	Lf	
WQGF	39.86	Mf		Southeastern Indiana Pr Co 306 E 3rd St	12 WDDP	39.86	Lf	US Rt 240 Westmore Md	WGLZ	33.06	Lf	
WQGF	39.86	Mf		Rushville Ind	12 WDDP	39.86	Lf	Wash Md	WAYW	—	—	
WQGF	39.86	Mf		Pike St Shelbyville Ind	WDDP	39.86	Lf	Wash St Tammany El Coop Inc	3 WAUO	31.46	Gf	
WQGF	39.86	Mf		Southeastern Ind Ru El Mem Corp 101 N Walnut	6 WEPI	39.66	Gf	Franklin La	3 WAUO	31.46	Gf	
WQGF	39.86	Mf		Osgood Ind	6 WEPI	39.66	Gf	Wash Suburban Gas Co 4601 Tanglewood Dr	3 WAWW	33.06	Lf	
WQGF	39.86	Mf		S								

PUBLIC UTILITIES — Continued

White City Rte Elec Mem Corp	Ohehanch Bldg	39.66	MI
Monticello Ind	4 WPG	39.66	MI
Whitely City Rte Elec Mem Corp	115 S Line	39.66	MI
Columbia City Ind	6 WIAL	39.66	MI
Wild Idlee Elec Coop Inc	2 KWRG	37.82	I
Mahnomen Minn	2 KWRG	37.82	I
Winnebago Rte Elec Coop Assn	KNCV	—	—
Thompson Iowa	KNCW	—	—
Mobile	—	—	—
Wisconsin Elec Pwr Co 231 W Mich Av	59 WQHL	39.86	GI
Milwaukee Wis	59 WQHL	39.86	GI
Wisconsin G&E Co Milwaukee Av	42 WBOG	39.86	GI
Ht Atkinson Wis	42 WBOG	39.86	GI
Flt St W Bend Wis	WQHK	39.86	GI
Wisconsin Michigan Pwr Co 137 W Mich St	16 WBMN	39.86	GI
Appleton Wis	16 WBMN	39.86	GI
1st Av Iron River Mich	WUW	39.86	GI
1223 S Milwaukee Av	WMPA	39.86	GI
Oconto Falls Wis	WQMR	39.86	GI
Worcester City Elec Co	20 WNQV	31.46	GI
Mobile	20 WNQV	31.46	GI
Wright-Hennepin Coop Elec Assn	25 KRZB	33.34	MI
Maple Lake Minn	25 KRZB	33.34	MI

TRANSIT UTILITY SERVICE

Alex Harcroft & Wash Transit	Cameron Mills Rd	39.86	GI
Alexandria Va	8 WAWR	39.86	GI
Baltimore Transit 10 N Calvert St	50 WBTS	35.02	LI
Baltimore Md	50 WBTS	35.02	LI
Boston Elev Ry Co	16 WDEA	35.15	GI
New York NY	16 WDEA	35.15	GI
Capital Transit Co 3222 M St NW	30 WQHA	31.46	GI
Washington DC	30 WQHA	31.46	GI
Chicago Surface Lines 231 S LaSalle St	55 WAYH	39.86	MI
Chicago Ill	55 WAYH	39.86	MI
Cincinnati St Ry Co Dixie Terminal Bldg	24 WAQE	31.46	MI
Cincinnati Ohio	24 WAQE	31.46	MI
City of Cleveland 1022 Carnegie Av	WDCZ	31.46	GI
Cleveland Ohio	WDCZ	31.46	GI
Delaware Coach Co 1300 Edgmont Av	10 WBYC	39.02	GI
Chester Pa	10 WBYC	39.02	GI
Denver Tramway Corp 14th & Arapahoe Sts	25 KRYF	72.26	MI
Denver Colo	25 KRYF	72.26	MI
St of Detroit Mich 3702 Barlum Tower	60 WALJ	31.46	AI
Detroit Mich	60 WALJ	31.46	AI
Fitchburg & Leom St Ry 1427 Water St	5 WCQE	39.66	GI
Fitchburg Mass	5 WCQE	39.66	GI
Fort Worth Transit Co 1528 E Lancaster	15 KIJJ	39.02	GI
Fort Worth Tex	15 KIJJ	39.02	GI
Houston Transit Co 800 Texas St	20 KWBX	72.50	MI
Houston Tex	20 KWBX	72.50	MI
Motor Transit Co 112 W Adams St	11 WCHK	39.86	MI
Jacksonville Fla	11 WCHK	39.86	MI
Kansas City Pub Serv Co 728 Delaware St	26 KINL	31.46	GI
Kansas City Mo	26 KINL	31.46	GI
Key System 1106 Bway	31 KYNN	39.66	GI
Oakland Calif	31 KYNN	39.66	GI
L A Transit Lines 962 W 12th Pl	47 KITF	31.46	GI
Los Angeles Calif	47 KITF	31.46	GI
Louisville Ry Co 29th & Bway	20 WTVU	39.02	MI
Louisville Ky	20 WTVU	39.02	MI
Motor Transit Co 36 Riverside Av	11 WCHK	39.86	MI
Jacksonville Fla	11 WCHK	39.86	MI
New Orleans Pub Ser 317 Baronne St	5 WNOO	39.86	MI
New Orleans La	5 WNOO	39.86	MI
Oklahoma Railway Co 1206 Exchange Av	5 KWNA	72.62	LI
Oklahoma City Okla	5 KWNA	72.62	LI
Phila Trans Co 1405 Locust St	58 WTVN	31.14	GI
Philadelphia Pa	58 WTVN	31.14	GI
Pittsburgh Ry Co 435 6th Av	18 WDRO	31.46	GI
Pittsburgh Pa	18 WDRO	31.46	GI
St Louis Pub Ser Co	2 KEHG	31.46	MI
St Louis Mo	2 KEHG	31.46	MI
Salt Lake City Lines 602 E 5th South St	8 KRCM	39.66	MI
Salt Lake City Utah	8 KRCM	39.66	MI
San Antonio Transit Co 310 So Mary's St	15 KSAE	39.86	MI
San Antonio Tex	15 KSAE	39.86	MI
City & Co of S F 901 Presidio Av	30 KCRJ	31.46	MI
San Francisco Calif	30 KCRJ	31.46	MI
San Diego Elec Ry 241 Bway	10 KSDR	39.86	MI
San Diego Calif	10 KSDR	39.86	MI
Spokane City Lines W 1229 Boone Av	10 KSKC	39.98	MI
Spokane Wash	10 KSKC	39.98	MI
Union St Ry Co 1959 Purchase St	8 WJGZ	39.02	GI
New Bedford Mass	8 WJGZ	39.02	GI
United Elec Ry Co 24 Exchange Pl	12 WJWF	31.46	GI
Providence Rte	12 WJWF	31.46	GI
Wash Marlboro & Annap Motor	15 WMNA	35.14	GI
Hardbury Hts Md	15 WMNA	35.14	GI
Wash Va & Md Coach Co 707 N Randolph St	7 WMVC	39.66	GI
Arlington Va	7 WMVC	39.66	GI
Worcester St Ry 287 Grove St	8 WMOS	31.46	GI
Worcester Mass	8 WMOS	31.46	GI

PETROLEUM PIPE LINE

Ark Western Gas Co Ark Western Wrehs	W5NAY	33.18	MI
Ozark Ark	W5NAY	33.18	MI
California Co	12 W5NCG	33.18	GI
Waterproof La	12 W5NCG	33.18	GI
C B Kline Drilling Co Eastham Bldg	35 W5NCG	33.26	GI
Midland Tex	35 W5NCG	33.26	GI
Continental Pipe Line Co Tank Farm	3 KCRB	39.66	MI
Brownsville Tex	3 KCRB	39.66	MI
Pump Sta Mercedes Texas	KCRD	39.66	MI
Pump Sta McAllen Texas	KCRE	39.66	MI
Hinson Camp Rio Grande City	KCRF	39.66	MI
Jackson Sta Sullivan City Tex	KSCW	39.66	MI
Humble Pipe Line Co	—	—	—
San Patricio Co Tex	KABO	37.46	LI
San Patricio Co (Ingleside)	KADID	37.46	LI
Office Humble PL Co Rt Bee Tex	KCRKQK	37.46	LI
Internt Oil Pipe Line Co Hewitt	50 KAJR	156.99	MI
Hewitt Okla	50 KAJR	156.99	MI
Nr Okla City Okla	KXDS	156.99	MI
J M Huber Corp 200 Block 1st St	50 KGTG	37.74	MI
Borger Tex	50 KGTG	37.74	MI
Pan American Pipe Line Co Hwy 259	15 KTHL	31.98	LI
Kilker Tex	15 KTHL	31.98	LI
Nr Quitman Tex	KTHM	31.98	LI
MP Railway Pl Isabel Tex	KTHJ	33.26	LI
Raymondville Tex	KTHJ	33.26	LI
Rogers Lacy Inc 227 Tyler St	W5XQR	33.18	KI
Longview Tex	W5XQR	33.18	KI
Mobile	W5XQS	33.18	KI
Shamrock Oil & Gas Corp McKee Pl	30 KRYV	37.50	MI
Surfay Tex	30 KRYV	37.50	MI
Stinclair Prairie Oil Co Pl 19	33 W5XAL	158.01	MI
Arp Tex	33 W5XAL	158.01	MI
Stanford Pipe Line Co	KQWF	2.292	a
Paula Valley Okla	KQWF	2.292	a
N Miles St Ada Okla	KQWG	153.71	MI
Hamilton Dome PS Kirby Wyo	KGRS	153.71	MI
Stanoline PL Pump Sta Kirby	KGRU	153.71	MI
Tenn Gas & Trans Co	100 WIAW	33.26	MI
Campbellville Ky	100 WIAW	33.26	MI

S of Catlettsburg Ky	WKMJ	33.26	MI
Clendenin WVA	WKNF	33.26	MI
Texoma Natural Gas Co	30 KQWK	33.26	MI
Nr Pritch Tex	30 KQWK	33.26	MI
Warren Petroleum Corp Federal Rte	12 KIRV	33.34	MI
Norworthy Tex	12 KIRV	33.34	MI
Lamarque Rd Texas City Tex	KIRX	33.34	MI

LIMITED COMMON CARRIER — EXPERIMENTAL

Am Radiotelephone Co 1407 Central	50 WOXMD	152.03	I
Kansas City Mo	50 WOXMD	152.03	I
Sherman Amsden 224 E 38th St	1 W2XLP	152.03	RI
New York NY	1 W2XLP	152.03	RI
Radio Dispatch Service 365 Lafayette St	25 W5XBR	152.03	MI
Baton Rouge La	25 W5XBR	152.03	MI
R C Crabb 1021 W 6th St	11 W6XYM	152.03	MI
Los Angeles Cal	11 W6XYM	152.03	MI
H Earl Daniels 884 Lucas Drive	10 W5XIB	152.03	MI
Beaumont Tex	10 W5XIB	152.03	MI
T E Daniels 2303 Brldlepath	10 W5XAS	152.03	MI
Austin Tex	10 W5XAS	152.03	MI
Austin Tex	W5XAH	152.03	MI
1721 Ky St San Antonio T	20 W5XND	152.03	MI
4333 Southwestern Dallas	10 W5XND	152.03	MI
L J Delamarter Jr 614 Mich Natl Bldg	100 W8XQI	152.03	MI
Grand Rapids Mich	100 W8XQI	152.03	MI
M Forsyth 4600 Broadview Av	10 W8XQO	152.03	MI
Cleveland Ohio	10 W8XQO	152.03	MI
Freepost Commun Radio Assn 17A W Sunrise Hwy	66 W2XYV	152.03	FI
Freeport NY	66 W2XYV	152.03	FI
J J Freke-Hayes 595 5th Av	55 W2XJJ	152.03	MI
New York NY	55 W2XJJ	152.03	MI
Ralph Hicks 120 E 9th St	100 W5XLA	152.03	MI
Tulsa Okla	100 W5XLA	152.03	MI
Indianapolis Transp Disp 320 N Meridian St	80 W9XTJ	152.03	LI
Indianapolis Ind	80 W9XTJ	152.03	LI
L M Kelley 519 White Hldg	100 W7XNY	152.03	GI
Seattle Wash	100 W7XNY	152.03	GI
Longview Radio Disp Ser 332 W Tyler St	25 W5XM	152.03	MI
Longview Tex	25 W5XM	152.03	MI
H V Lowe 10910 Kinross Av	W6XZO	152.03	a
Los Angeles Calif	W6XZO	152.03	a
Madison Mobile Disp Radio Ser 643 1/2 E Wilson	12 W9NDQ	152.03	MI
Madison Wis	12 W9NDQ	152.03	MI
Marine Radio Co 526 St Paul Pl	2 W3NBB	152.03	MI
Baltimore Md	2 W3NBB	152.03	MI
Mobile Disp Ser 1520 Fidelity Trust Bldg	50 W3NNV	152.03	LI
Baltimore Md	50 W3NNV	152.03	LI
Mobile Radio Tel Co 1707 H St NW	50 W3XMG	152.03	MI
Washington DC	50 W3XMG	152.03	MI
Mobile Radiophone Ser 1549 Pratt St	20 W3XHH	152.03	MI
Philadelphia Pa	20 W3XHH	152.03	MI
Mobile Radio Tel Co 66 Monroe St	50 W4XNJ	152.03	MI
Memphis Tenn	50 W4XNJ	152.03	MI
914 S Gay St Knoxville	50 W4XCL	152.03	MI
Knoxville Tenn	50 W4XCL	152.03	MI
517 Commerce St	50 W4XCN	152.03	MI
332 W Hwy Louisville Ky	50 W4XCR	152.03	MI
Mobile Radio Inc 712 8th St	10 W6XEP	152.03	FI
Cresley Colo	10 W6XEP	152.03	FI
Mobile Radio Tel Co 1700 Glenarm Pl	W0XMF	152.03	MI
Denver Colo	W0XMF	152.03	MI
5 W 4th Cincinnati O	50 W8XAT	152.03	MI
8 E Broad St Columbus O	50 W8XHG	152.03	MI
420 Jefferson Av Toledo O	50 W8XBI	152.03	MI
1249 Wash Blvd Detroit	50 W8XQR	152.03	MI
715 Market Chattanooga Ga	50 W4XDB	152.03	MI
Humphrey's Radio Disp Ser 613 Poydras St	100 W5XBF	152.03	MI
New Orleans La	100 W5XBF	152.03	MI
Natl Elec Labs Inc 200 Kink St	W4XNE	30.66	I
Alexandria Va	W4XNE	30.66	I
N Chicago Mobile Radio Ser 1742 Sheridan Rd	25 W9XNY	152.03	MI
N Chicago Ill	25 W9XNY	152.03	MI
Odessa Radio Disp Ser 210 N Hancock St	25 W5XWW	152.03	MI
Odessa Tex	25 W5XWW	152.03	MI
G A O'Reilly 31 N Knoxville	10 W5XCR	152.03	MI
Adrian Mich	10 W5XCR	152.03	MI
Radio Disp Inc 1619 E Republic	100 W7XNW	152.03	MI
Seattle Wash	100 W7XNW	152.03	MI
Radio Disp Inc 1005 Peachtree Rd	62 W4XAR	152.03	MI
Augusta Ga	62 W4XAR	152.03	MI
Radio Disp Inc 132 N Winter St	15 W8NEJ	152.03	RI
22 W Jackson Battle Cr	50 W8NRW	152.03	MI
Radio Marine Corp of Amer	10 W2XGG	152.03	I
New York NY	10 W2XGG	152.03	I
Radiofone Inc 523 W Markham St	25 W5XVX	152.03	MI
Little Rock Ark	25 W5XVX	152.03	MI
Hickory Hill Radio Disp Ser Friends Sta PO B65	60 W9XAV	152.03	LI
Richmond Ind	60 W9XAV	152.03	LI
Rockford Radio Disp 217 S Church St	W9XCD	152.03	MI
Rockford Ill	W9XCD	152.03	MI
W C Rogers 55 E Washington St	10 W9XCM	152.03	MI
Chicago Ill	10 W9XCM	152.03	MI
Loyal Radio Disp Ser 1914 3rd Av	40 W9NEI	152.03	MI
Rock Island Ill	40 W9NEI	152.03	MI
Solomon Schiller 66 Willoughby St	100 W2XTJ	152.03	MI
Brooklyn NY	100 W2XTJ	152.03	MI
Shreveport Radio Disp Ser PO Box 3676	25 W5XQ	152.03	MI
New Orleans La	25 W5XQ	152.03	MI
Tanner Radio & Elect Sup 109 W 9th St	10 W5XZB	152.03	GI
Little Rock Ark	10 W5XZB	152.03	GI
Tel Answering Exch 410 Main St	20 W9XCK	152.03	MI
Peoria Ill	20 W9XCK	152.03	MI
Tel Message Exch 312 E Wisconsin St	50 W9XCO	152.03	MI
Milwaukee Wis	50 W9XCO	152.03	MI
Transp Commun Ser Inc 224 N Wrenn St	50 W4XLA	152.03	RI
High Point NC	50 W4XLA	152.03	RI
Twin City Garage 5124 E Imperial St	2 W6XAI	152.15	LI
Lynwood Calif	2 W6XAI	152.15	LI
Twin City Radio Disp 206 Lumber Exch Bldg	20 W6XNC	152.03	MI
Minneapolis Minn	20 W6XNC	152.03	MI
C-Dryvit Auto Rental Co 4 Liberty St	100 W1XNZ	152.03	MI
Boston Mass	100 W1XNZ	152.03	MI
Wash Radio Disp Message Ser 4419 Ga Av NW	20 W3XWS	157.29	MI
Washington DC	20 W3XWS	157.29	MI
N Z Wolpert 225 S 5th St	100 W6XMI	152.03	MI
Minneapolis 2 Minn	100 W6XMI	152.03	MI

HIGHWAY MAINTENANCE

State of Calif Donner Summit Maint Sta	KAON	2.726	a
Norden Calif	KAON	2.726	a
Mobile	7 KQGV	37.98	MI
1657 Riverside Redding Cal	KASN	2.726	a
St Hwy Main Quincy Cal	KATQ	2.726	Ka
US Hwy 99 Mt Shasta Cal	KATR	2.726	Ka
S H 29 Hwy Maint Susanville	KATS	2.726	Ka
Maint Yard on US 99 Yreka	KATT	2.726	Ka
S H 29 Mineral Calif	KATU	2.726	Ka
Pulka Cal	KATV	2.726	Ka
US 395 Alturas Cal	KATW	2.726	Ka
US 299 Burney Cal	KATX	2.726	Ka
US 395 Conway Summit Cal	KBTG	2.726	Ka
US 395 Sonora Junct Cal	KHTD	2.726	Ka
Div Hwy 703B St Marysville	KQGC	2.726	a
Maint St US 40 Truckee Cal	KQGD	2.726	a
Maint Sta St Rt 18 Lk Arrowhead	KQGI	2.726	Ka

Maint Sta San Bernardino C	KQJG	2.726	Ka
247 3rd St San Bernardino	KQGN	2.726	a
US 395 Crestview Cal	KQGG	2.726	Ka
Hwy Dist US 395 Bishop Cal	KQGM	2.726	a
Maint Sta US 50 Bاده Calif	KRMA	2.726	a
301 Pub Works Bldg Sacramento	KRNF	2.726	Ha

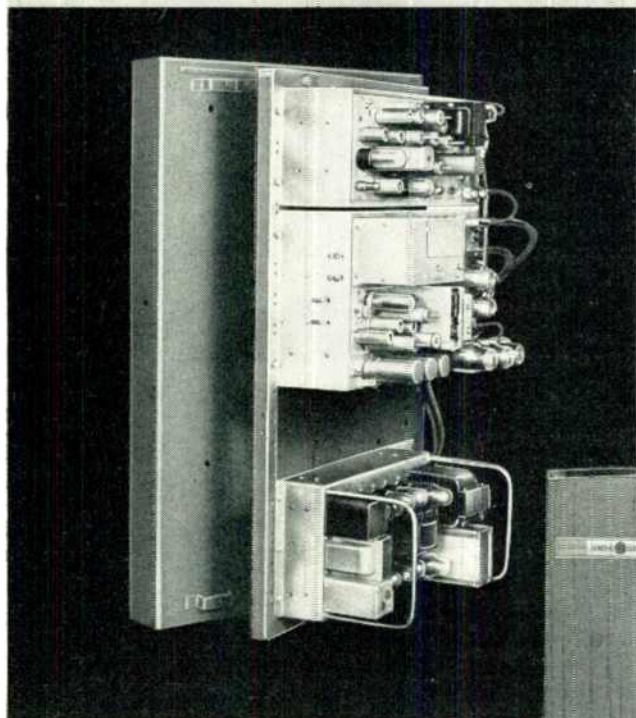
HIGHWAY MAINTENANCE — EXPERIMENTAL

Dist of Columbia 201 Bryant St NW	10 W3XOE	37.98	LI</
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Depend upon it

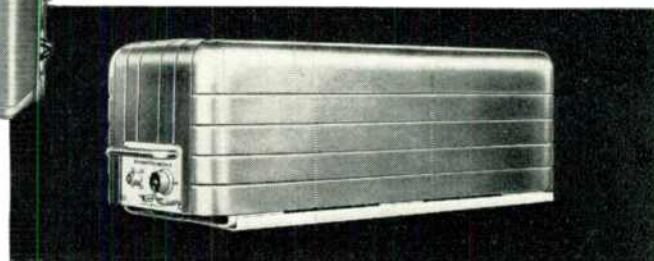


152-162 mc 2-WAY
RADIO EQUIPMENT
GETS *Action!*



A COMPLETE LINE... Headquarters and mobile stations (2-way operation) • Standard and high-gain antennas • Wide variety of transmission line and accessories • Choice of special dispatching microphones Local and remote control units • Selective calling (optional) Testing and frequency measuring equipment.

IN EVERY operation where instant, reliable contact is required, General Electric's new 152-162 mc 2-way communications equipment can be depended upon. Here is a *complete* system that aids in systematizing and coordinating operations. It is filled with features that mean better performance, longer life, greater dependability.



CENTRAL STATION FEATURES

1. Hinged rack construction provides maximum accessibility.
2. Wall-mounted cabinet—zero floor space required.
3. Rack-mounted selective dialing unit (optional).
4. Full 50 watts output—tubes and components operated well under ratings.
5. Meets proposed RMA standards—high attenuation of spurious receiver response and spurious transmitter and receiver radiation.
6. SYNCHRO-CYCLE circuit insures continuous peak receiver performance.

Be sure of results—let General Electric handle the complete job from microphone to antenna. General Electric engineers are located in principal cities. For complete information and assistance in planning your radio system, call or write your nearest General Electric office or the General Electric Company, Electronics Department, Syracuse 1, New York.

MOBILE STATION FEATURES

1. Single-unit chassis—plug-in, draw-out construction.
2. Plug-in receiver, transmitter, and selective receiving (optional) sub-chassis—no maintenance delays—no extra boxes.
3. SYNCHRO-CYCLE receiver tuning with crystal control.
4. Meets proposed RMA standards.
5. Temperature-controlled transmitter crystal—the reliable General Electric Thermocell Crystal.
6. Alnico V 6½ inch speakers.
7. Accessories to fit the basic units to your requirements.

FIRST AND GREATEST NAME IN ELECTRONICS

GENERAL  ELECTRIC

163-F1-6910

TRUCKS, BUSES, TAXIS — Continued

Atomic Taxi Co 1 16th Av	10 W2XZII	157.53	Lf
Paterson NJ	2 W8XAP	157.53	Mf
Auburn Yellow Cab Co 1827 Cleveland Av NW	50 W2XTI	157.41	Mf
Canton Ohio	6 W8XKX	157.41	Mf
Automobile Club of Buffalo SE Wash & Clinton	12 W6XSP	157.53	Mf
Buffalo NY	50 W2XU	157.41	Mf
Automobile Club of NY 28 E 78th St	12 W6XSP	157.53	Mf
New York 21 NY	50 W2XU	157.41	Mf
Automobile Club of Mich 139 Bagley	12 W6XSP	157.53	Mf
Detroit Mich	50 W2XU	157.41	Mf
Automobile Club of 8 Calif 2601 S Figueroa	12 W6XSP	157.53	Mf
Los Angeles Calif	50 W2XU	157.41	Mf
Badger Cab Co 16 S Bedford St	12 W6XSP	157.53	Mf
Madison Wis	50 W2XU	157.41	Mf
L S Bambauer MD RFD Round Valley	12 W6XSP	157.53	Mf
Bishop Calif	50 W2XU	157.41	Mf
Barberton Cab Co 313 6th St	12 W6XSP	157.53	Mf
Barberton Ohio	50 W2XU	157.41	Mf
Barnes-Dwile Co 120 N Main St	12 W6XSP	157.53	Mf
Eldorado Kans	50 W2XU	157.41	Mf
Barnes Taxi 123 N Salt Pond St	12 W6XSP	157.53	Mf
Marshall Mo	50 W2XU	157.41	Mf
Barnette & Barnette 112 N Rway	12 W6XSP	157.53	Mf
Minden La	50 W2XU	157.41	Mf
Beach Taxi Inc 253 Wash Av	12 W6XSP	157.53	Mf
Winthrop Mass	50 W2XU	157.41	Mf
Beaumont Hotel Co 201 Main St	12 W6XSP	157.53	Mf
Green Bay Wis	50 W2XU	157.41	Mf
Bell Cab Co 130-27 Av	12 W6XSP	157.53	Mf
Gulfport Miss	50 W2XU	157.41	Mf
Bell Cab 16 E 6th St	12 W6XSP	157.53	Mf
Chester Pa	50 W2XU	157.41	Mf
Bell Cab Co 14 Fairview Av	12 W6XSP	157.53	Mf
Trenton NJ	50 W2XU	157.41	Mf
Bell Taxi 948 Ontario Av	12 W6XSP	157.53	Mf
Niagara Falls NY	50 W2XU	157.41	Mf
Bell Taxi Co 113 S 1st St	12 W6XSP	157.53	Mf
Temple Tex	50 W2XU	157.41	Mf
Bellingham City Taxi 210 W	12 W6XSP	157.53	Mf
Bellingham Wash	50 W2XU	157.41	Mf
Baltimore Taxi Service 215 S Front St	12 W6XSP	157.53	Mf
Marquette Mich	50 W2XU	157.41	Mf
Belleville Cab Co 102 N Illinois	12 W6XSP	157.53	Mf
Belleville Ill	50 W2XU	157.41	Mf
Peter Edward Bender 217 S Wash Av	12 W6XSP	157.53	Mf
Saginaw Mich	50 W2XU	157.41	Mf
Bennie's Cab Co 28 N Main St	12 W6XSP	157.53	Mf
Helena Montana	50 W2XU	157.41	Mf
Benwood Taxi Co Benwood Hotel	12 W6XSP	157.53	Mf
Emmings Ill	50 W2XU	157.41	Mf
J B Berkebile MD 15 W 6th St	12 W6XSP	157.53	Mf
Peru Ind	50 W2XU	157.41	Mf
Berry Cab Co 140 N Elsworth Av	12 W6XSP	157.53	Mf
Salem Ohio	50 W2XU	157.41	Mf
Bert & Steve Cab Co 1030 Burnett St	12 W6XSP	157.53	Mf
Ft Worth Texas	50 W2XU	157.41	Mf
Beverly Taxi Co 9 Enon St	12 W6XSP	157.53	Mf
Beverly Mass	50 W2XU	157.41	Mf
Sam Bigham 423 Oak St	12 W6XSP	157.53	Mf
Graham Tex	50 W2XU	157.41	Mf
Bills Cab 1508 Welston St	12 W6XSP	157.53	Mf
Denver Colo	50 W2XU	157.41	Mf
Bills Taxi 40 E Steuben St	12 W6XSP	157.53	Mf
Bath NY	50 W2XU	157.41	Mf
Bills Taxi 515 S Main	12 W6XSP	157.53	Mf
Moscow Idaho	50 W2XU	157.41	Mf
Bills City Taxi 1510 High St	12 W6XSP	157.53	Mf
Seattle Wash	50 W2XU	157.41	Mf
Bills Towing Service 2421 5th Av	12 W6XSP	157.53	Mf
Seattle Wash	50 W2XU	157.41	Mf
Billy's Cab Co 10th & Main	12 W6XSP	157.53	Mf
Lexington Mo	50 W2XU	157.41	Mf
Birmingham Vets Cab Co 1351 Buffner St	12 W6XSP	157.53	Mf
Birmingham Mich	50 W2XU	157.41	Mf
BKW Coach Line 24 S 4th St	12 W6XSP	157.53	Mf
Sunbury Pa	50 W2XU	157.41	Mf
Black & White Duluth Cab Co 14 E 1st St	12 W6XSP	157.53	Mf
Duluth Minn	50 W2XU	157.41	Mf
Black & White Cab Co 124 Gordon St	12 W6XSP	157.53	Mf
Dalton Ga	50 W2XU	157.41	Mf
Black & White Cab 317 Main	12 W6XSP	157.53	Mf
Texarkana Tex	50 W2XU	157.41	Mf
Black & White Cab Co 23 N 9th St	12 W6XSP	157.53	Mf
Fort Smith Ark	50 W2XU	157.41	Mf
Black & White Inc 113 N Main St	12 W6XSP	157.53	Mf
Little Rock Ark	50 W2XU	157.41	Mf
Black & White Cab Co 319 W "B" Street	12 W6XSP	157.53	Mf
Russellville Ark	50 W2XU	157.41	Mf
Black & White Cab Co W 304 Sprague Av	12 W6XSP	157.53	Mf
Spokane Wash	50 W2XU	157.41	Mf
Black & White Cab Co Hotel Boise	12 W6XSP	157.53	Mf
Boise Idaho	50 W2XU	157.41	Mf
Black & White Cab Co 328 7th St	12 W6XSP	157.53	Mf
Parkersburg W Va	50 W2XU	157.41	Mf
Black & White Cab Co 313 Waukegan Av	12 W6XSP	157.53	Mf
Highwood Ill	50 W2XU	157.41	Mf
Black & White Taxi Service 321-329 Main	12 W6XSP	157.53	Mf
Utica NY	50 W2XU	157.41	Mf
Blair Taxi Co 119 Alleghany St	12 W6XSP	157.53	Mf
Hollidaysburg Pa	50 W2XU	157.41	Mf
B-Line Taxi 4 Chestnut St	12 W6XSP	157.53	Mf
Onondaga NY	50 W2XU	157.41	Mf
Bloomfield Cab Co Inc 535 Bloomfield Av	12 W6XSP	157.53	Mf
Bloomfield NJ	50 W2XU	157.41	Mf
Blue & Gold Cab Co 1754 Shattuck Av	12 W6XSP	157.53	Mf
Berkeley Calif	50 W2XU	157.41	Mf
Blue Bird Cab Co 115 W Wash St	12 W6XSP	157.53	Mf
Greenville SC	50 W2XU	157.41	Mf
Blue Bird Cab Co 115 W Wash St	12 W6XSP	157.53	Mf
Greenville SC	50 W2XU	157.41	Mf
Blue Bird Cab Co 225 N Trade St	12 W6XSP	157.53	Mf
Winston-Salem NC	50 W2XU	157.41	Mf
Blue Bird Cab Co 402 Victoria Av	12 W6XSP	157.53	Mf
Lynchburg Va	50 W2XU	157.41	Mf
Blue Bird Taxi Co 64 S Lexington Av	12 W6XSP	157.53	Mf
Asheville NC	50 W2XU	157.41	Mf
Blue Bird Taxi 229 E Sycamore St	12 W6XSP	157.53	Mf
Greensboro NC	50 W2XU	157.41	Mf
Blue Line Cab Service 920 W Grand Av	12 W6XSP	157.53	Mf
Wisconsin Rapids Wis	50 W2XU	157.41	Mf
Blue Line Taxicab Co 126 S Center St	12 W6XSP	157.53	Mf
Casper Wyo	50 W2XU	157.41	Mf
Blue Taxi Co 824 E 4th St	12 W6XSP	157.53	Mf
Alton Ill	50 W2XU	157.41	Mf
Blue & White Cab Co 2001 N Water St	12 W6XSP	157.53	Mf
Corpus Christi Tex	50 W2XU	157.41	Mf
Bob's Auto Rental Inc 450 Richmond Terr	12 W6XSP	157.53	Mf
New Brighton NY	50 W2XU	157.41	Mf
Boss Taxi Service 97 E Main St	12 W6XSP	157.53	Mf
Gowanda NY	50 W2XU	157.41	Mf
Boston Cab Co 51 Symphony Rd	12 W6XSP	157.53	Mf
Boston Mass	50 W2XU	157.41	Mf
M J Bowen 160 Lake St	12 W6XSP	157.53	Mf
Newport Vt	50 W2XU	157.41	Mf
Boynton Cab Co 1232 N Edison St	12 W6XSP	157.53	Mf
Malwaukee 2 Wis	50 W2XU	157.41	Mf
Brazal's Taxi Service 96 3rd St	12 W6XSP	157.53	Mf
Troy NY	50 W2XU	157.41	Mf
Brand's Cab Service 206 Sheldon Av	12 W6XSP	157.53	Mf
Houghton Mich	50 W2XU	157.41	Mf

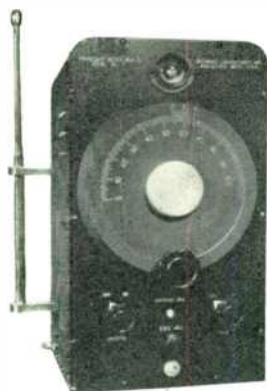
Brentwood Cab Co 4131 Brownsville Rd	157.53	Mf
Pittsburgh 27 Pa	20 W3XQJ	157.53
Brighton Taxi Co 46 Village Lane Brighton Sta	4 W2XU	157.53
Rochester NY	4 W2XU	157.53
Broadway Deluxe Cab Co 115 NW Hwy	100 W7XID	157.53
Portland Ore	14 W7XID	157.53
Broadway Yellow Cab Co 2713 1st N	15 W2XIA	157.53
Billings Montana	15 W2XIA	157.53
Brooks Suburban Inc 11 Halstead St	15 W2XIA	157.53
Orange NJ	15 W2XIA	157.53
Brown & White Cab Assn 22 S Sussex Av	15 W2XIA	157.53
Newark NJ	15 W2XIA	157.53
Brown & White Cab Co 171 Univ Av	48 W0XSNQ	157.53
St Paul Minn	48 W0XSNQ	157.53
Brown's Cab 924 Av G	5 W0XEL	157.53
Port Madison, Iowa	5 W0XEL	157.53
Bruce's Red Top Taxi 312 N 16th St	6 W9X0Z	157.53
Watson Ill	6 W9X0Z	157.53
Bryant's Taxi 1206 13th St	10 W5XRS	157.53
Lubbock Tex	10 W5XRS	157.53
Buddies Taxi Service 134 Waverly St	2 W1XMT	157.53
Framingham Mass	2 W1XMT	157.53
Burlington Cab Co 1009 Mebane St	8 W4XTD	157.53
Burlington NC	8 W4XTD	157.53
Busard Taxi & Bus Service 3395 S Lincoln	51 W0XBB	157.53
Englewood Colo	51 W0XBB	157.53
Cab Services Inc 335 Gateway Bank Bldg	50 W0XMM	157.53
Minneapolis Minn	50 W0XMM	157.53
Cabe Inc 1636 Glenarm Place	135 W0XFF	157.53
Denville Colo	135 W0XFF	157.53
Caldwell Cab Co 115 Hightower St	20 W4XDJ	157.53
Thomaston Ga	20 W4XDJ	157.53
Calexico Taxi Co Box 961	5 W6XDM	157.53
Calexico Calif	5 W6XDM	157.53
Calif State Automobile Assn 150 Van Ness Av	5 W6XCF	157.41
San Francisco 2 Calif	5 W6XCF	157.41
St of Calif Div of Hwy 1120 N St	6 W6XYD	2.455 a
Sacramento Calif	6 W6XYD	2.455 a
Callahan Taxi Service 193 Western Av	2 W1XMT	157.53
Brattleboro Vt	2 W1XMT	157.53
Cape Bway Cab Co 702 Bway	15 W0XMU	157.53
Cape Girardeau Mo	15 W0XMU	157.53
Capitol Hill Taxi Oper Co 133 SW 24th St	50 W5XIDM	157.53
Oklahoma City Okla	50 W5XIDM	157.53
Carbondale Transfer Co 45 N Main St	10 W3XID	157.53
Carbondale Pa	10 W3XID	157.53
Caribe Electronics PO Box 4881	3 K4XON	154.89
San Juan 24 Puerto Rico	3 K4XON	154.89
Carl's Cabs 422 Montgomery Av	10 W4XVZ	157.53
Sheffield Ala	10 W4XVZ	157.53
Carolina Cab Co 104 Market St	23 W4XUG	157.53
Charleston SC	23 W4XUG	157.53
Carpenter's Cabs Box 6	4 W4XUG	157.53
Lincoln Neb	4 W4XUG	157.53
Norman Carver 126 N First Av	8 W9XJX	157.53
Wausau Wis	8 W9XJX	157.53
Central Cabs 103 Murray Av	41 W1XFI	157.53
Worcester Mass	41 W1XFI	157.53
Central Cab Co 532 Forrest Av	21 W1XJB	157.53
Portland Maine	21 W1XJB	157.53
Central Cab 130 N Seales St	6 W4XZP	157.53
Reldsville NC	6 W4XZP	157.53
Central Taxi 2 Jackson St	6 W1XER	157.53
Lowell Mass	6 W1XER	157.53
Central Taxi Co 11 North St	6 W2XOH	157.53
Auburn NY	6 W2XOH	157.53
Central Taxi-Blue Cab Co 266 W Beau St	15 W3XHT	157.53
Washington Pa	15 W3XHT	157.53
Century Cab Co 3rd St & 3rd Av SE	16 W0XEN	157.53
Cedar Rapids Ia	16 W0XEN	157.53
Century Taxi Co 200 E Jefferson St	15 W2XZD	157.53
Syracuse NY	15 W2XZD	157.53
Chapman Cab Co 3308 Wash Av	10 W4XPY	157.53
Newport News Va	10 W4XPY	157.53
Charlie's Taxi Service 145 N 6th Av	5 W2XCM	157.53
Manville NJ	5 W2XCM	157.53
Chattanooga Trans Co 912 Market St	30 W4XVG	157.53
Chattanooga Tenn	30 W4XVG	157.53
Checker Cab Co Inc 2124 St Mary's Av	100 W0XFY	152.27
Omaha Neb	100 W0XFY	152.27
Checker Cab Co 323 4th St	10 W0XHB	157.53
Blismarek ND	10 W0XHB	157.53
Checker Cab Co 1415 Tremont St	50 W0XJP	157.53
Dover 2 Calif	50 W0XJP	157.53
Checker Taxi Co	10 W1XFT	157.53
Boston Mass	10 W1XFT	157.53
Checker Cab Co 3901 Terrace Av	10 W2XTG	157.53
Pennsauken NJ	10 W2XTG	157.53
Checker Cab Co 117 E 10th St	10 W3XGI	157.53
Orle Pa	10 W3XGI	157.53
Checker Cab Main & Swede Sts	6 W3XMK	157.53
Norristown Pa	6 W3XMK	157.53
Checker Cab Co 705 Saluda Av	56 W4XNN	157.53
Columbia SC	56 W4XNN	157.53
Checker Cab Co 303 W Whitner St	14 W4XWG	157.53
Anderson SC	14 W4XWG	157.53
Checker Cab Co PO Box 423	150 W5XWM	157.53
New Orleans La	150 W5XWM	157.53
Checker Cab Co 330 Central Av	30 W5XNZ	157.53
Hot Springs Ark	30 W5XNZ	157.53
Checker Cab & Transfer Co 265 Lafayette	25 W5XOV	157.53
Baton Rouge La	25 W5XOV	157.53
Checker Cab Co 115 N Grant	15 W5XQL	157.53
Odessa Tex	15 W5XQL	157.53
Checker Cab Co 502 Dolorosa St	100 W5XSK	157.53
San Antonio Tex	100 W5XSK	157.53
Checker Cab Co 114 S First St	15 W5XTS	157.53
Temple Tex	15 W5XTS	157.53
Checker Cab Co 468 E St	30 W6XPR	157.53
San Bernardino Calif	30 W6XPR	157.53
Checker Cab Co 100 Ridge St	10 W8XLD	157.53
Sault Ste Marie Mich	10 W8XLD	157.53
Checker Cab Co 331 Adams St	17 W9XPO	157.53
Steubenville Ohio	17 W9XPO	157.53
Checker Cab Co 1106 Franklin St	15 W9XJZ	157.53
Michigan City Ind	15 W9XJZ	157.53
Checker Cab Co 621 N Main St	12 W9XKR	157.53
Kokomo Ind	12 W9XKR	157.53
Checker Cab Co 1655 N Water St	15 W5XYQ	157.53
Milwaukee Wis	15 W5XYQ	157.53
Checker Cab Co 22 N Colorado St	13 W9XFB	157.53
Midland Tex	13 W9XFB	157.53
Checker Cab Co 34 N Bway	12 W9XPH	157.53
Aurora Ill	12 W9XPH	157.53
Checker-Yellow Cab Co 329 Pine St	31 W9XTT	157.53
Green Bay Wis	31 W9XTT	157.53
Checker Taxi Co 148 S Blair St	65 W4XDT	157.53
Madison Wis	65 W4XDT	157.53
Checker Cab Inc 840 5th St	20 W7XBQ	157.53
Miami Beach Fla	20 W7XBQ	157.53
Checker Cab Co 1808 O'Neil St	3 W7XQX	157.53
Cheyenne Wyo	3 W7XQX	157.53
Checker Taxi Co 302 Sherman Av	10 W10XDX	198 f
Coeur d'Alene Idaho	10 W10XDX	198 f
Cheapeake & Ohio Rly Co 823 E Main St	20 W9XAC	157.41
Richmond 10 Va	20 W9XAC	157.41
Chicago Motor Club 66 E S Water St	6 W1XEC	157.53
Chicago 1 Ill	6 W1XEC	157.53
Christie Cab Co 6 Bank St	10 W8XMQ	157.41
Waterbury Conn	10 W8XMQ	157.41
Chinatti Automobile Club Central Pkwy		
Cincinnati Ohio		

Circle Cab Co 118 E Washington Place	45 W8XHK	157.53	Mf
Springfield Ohio	45 W8XHK	157.53	Mf
Citizens Red Line Taxi 44 N 5th Av	15 W7XPJ	157.53	Bf
Tucson Ariz	15 W7XPJ	157.53	Bf
City Cab Co 2202 Lane St	2 W0XDV	157.53	Mf
Falls City Neb	2 W0XDV	157.53	Mf
City Cab Co 11b N Main St	10 W0XHIL	157.53	Mf
Minneapolis	10 W0XHIL	157.53	Mf
City Cab Co 306 Beltrami Av	5 W0XIF	157.53	Bf
Hemidjl Minn	5 W0XIF	157.53	Bf
City Cab Co Inc 253 Main St	12 W1XGV	157.53	Bf
Fitchburg Mass	12 W1XGV	157.53	Bf
City Cab Co 10 PO Sq	12 W1XMC	157.53	Rf
Taunton Mass	12 W1XMC	157.53	Rf
City Cab Co 383 Lisbon St	10 W1XND	157.53	Mf
Lewiston Me	10 W1XND	157.53	Mf
City Cab Co 23 Fenton Place	12 W2XSW	157.53	Rf
Jamestown NY	12 W2XSW	157.53	Rf
City Cab 840 Ashbury Av	10 W2XT8	157.53	Lf
Ocean City NJ	10 W2XT8	157.53	Lf
City Cab Co 1050 Blair Av	2 W3XHU	157.53	Lf
Tyrone Pa	2 W3XHU	157.53	Lf
City Cab 341 N Wash Av	PO Box 1098	157.53	Df
Pulaski Va	10 W4XRQ	157.53	Df
City Cab 215 E Main St	10 W4X8J	157.53	Bf
Front Royal Va	10 W4X8J	157.53	Bf
City Cab Co 329 2nd St	3 W4XSW	157.53	Gf
Henry Ariz	3 W4XSW	157.53	Gf
City Cab 1126 N Hudson St	20 W4XTW	157.53	Gf
Arlington Va	20 W4XTW	157.53	Gf
City Cab Co 243 S Orange Av	25 W4XTZ	157.53	f
Orlando Fla	25 W4XTZ	157.53	f
City Cab Co 408 Montgomery St	10 W4XXI	157.53	Lf
Montgomery Ala	10 W4XXI	157.53	Lf
City Cab 115 S Augusta St	15 W4XXU	157.53	Lf
Staunton Va	15 W4XXU	157.53	Lf
City Cab Co 434 W Univ. Av	12 W4XZC	157.53	f
Gainesville Fla	12 W4XZC	157.53	f
City Cab Co 701-3 Hamilton St	6 W4XZL	157.53	Bf
Leakens NC	6 W4XZL	157.53	Bf
City Cab Co 107 E 4th St	7 W5XOL	157.53	Bf
Odessa Tex	7 W5XOL	157.53	Bf
City Cab Co 401 N Spring St	10 W5XPM	157.53	Ba
Tyler Tex	10 W5XPM	157.53	Ba
City Cab Co 109 S Theobald	10 W5XLP	157.53	Mf
Greenville Miss	10 W5XLP	157.53	Mf
City Cab Co 1308 Bway	20 W5XRV	157.53	Pf
Lubbock Tex	20 W5XRV	157.53	Pf
City Cab Co 118 Austin St	10 W5XSO	157.53	f
Denton Tex	10 W5XSO	157.53	f
City Cab Co 626 N Main St	15 W5XUY	157.53	a
Borger Tex	15 W5XUY	157.53	a
City Cab Co 117 W 6th St	15 W5XWD	157.53	Mf
Amarillo Tex	15 W5XWD	157.53	Mf
City Cab Co 512 W Larkin	15 W5XYB	157.53	Rf
Athens Tex	15 W5XYB	157.53	Rf
City Cab 511 Ramond St	10 W6XCC	157.53	Mf
Corona Calif	10 W6XCC	157.53	Mf
City Cab Co 214 Kirk St	2 W6XOT	157.53	a
Presno 2 Calif	2 W6XOT	157.53	a
City Cab Co 458 1/2 Bell Flower	10 W6X8J	157.53	Mf
Bellflower Calif	10 W6X8J	157.53	Mf
City Cab Co 1 W Vine St	4 W8XIJ	157.53	Mf
Mt Vernon Ohio	4 W8XIJ	157.53	Mf
City Cab Co 160 Water St	12 W8XJK	157.53	Mf
Hendon Harbor Mich	12 W8XJK	157.53	Mf
City Cab Co 411 Broad St	6 W8XOU	157.53	Mf
Port Huron Mich	6 W8XOU	157.53	Mf
City Cab Co 219 W Court St	6 W8XPB	157.53	Mf
Washington C H Ohio	12 W8XPL	157.53	Mf
City Cab Co 124 E Crawford St	12 W8XPL	157.53	Mf
Findlay Ohio	12 W8XPL	157.53	Mf
City Cab Co 207 N 4th St	8 W8XRK	157.53	Mf
Niles Mich	8 W8XRK	157.53	Mf
City Cab Co 60 N Main St	14 W9XKV	157.53	Mf
Oshkosh Wis	14 W9XKV	157.53	Mf
City Cab Co 408 E Hlekyr	4 W9XND	157.53	Mf
Streeter Ill	4 W9XND	157.53	Mf
City Cab Co 108 E Main St	5 W9XSG	152.27	Mf
Benton Ill	5 W9XSG	152.27	Mf
City Cab Co 14 N Locust	10 W9XVS	157.53	Mf
Janesville Wis	10 W9XVS	157.53	Mf
City Cab Co 1031 19th St	8 W6XDK	157.53	Mf
Bakersfield Calif	8 W6XDK	157.53	Mf
City Cab Co 206 W Liberty St	6 W0XNQ	157.53	Mf
Farmington Mo	6 W0XNQ	157.53	Mf
City Cab Co 129 Westminster St	50 W1XNR	157.53	Mf
Providence RI	50 W1XNR	157.53	Mf
City Cab Co 531 State St	50 W9XNJ	157.53	Mf
Madison Wis	50 W9XNJ	157.53	Mf
City Hall Taxi 1383 Wash St	8 W1XNJ	157.53	Rf
W Newton Mass	8 W1XNJ	157.53	Rf
City Service Taxicab 430 Genesee St	30 W2XOW	157.53	Mf
Buffalo NY	30 W2XOW	157.53	Mf
City Taxi 3604 Wash Av	6 W4XBL	157.53	Bf
Newport News Va	6 W4XBL	157.53	Bf
City Taxi Co 113 N Brewer St	10 W4XIE	157.53	Mf
Paris Tenn	10 W4XIE	157.53	Mf
City Taxi Co 511 East K St	5 W7XOW	157.53	a
Grants Pass Ore	5 W7XOW	157.53	a
City Taxi Service 700 S Court St	12 W6XBI	157.53	Mf
Visalia Calif	12 W6XBI	157.53	Mf
City Taxi Service 130 South L	4 W6XLY	157.53	Mf
Tulare Calif	4 W6XLY	157.53	Mf
City Taxi Service 918 2nd St	3 W6XIW	157.53	Bf
Porterville Calif	3 W6XIW	157.53	Bf
City Taxi Service 123 W 3rd St	10 W9XBW	157.53	Bf
Rushville Ind	10 W9XBW	157.53	Bf
City Taxi Service 618 W 2nd St	8 W8XRI	157.53	Mf
Defiance Ohio	8 W8XRI	157.53	Mf
City Transit Taxi 320 S Garay Av	20 W6XQJ	157.53	Mf
Pomona Calif	20 W6XQJ	157.53	Mf
City Trans Co 610 S Akard St	250 W5XON	157.53	Gf
Balises Tex	250 W5XON	157.53	Gf
Modern Delivery Service 1120 S Olive St	6 W6XRG	157.53	Lf
Los Angeles Calif	6 W6XRG	157.53	Lf
City Yellow Cab Co 356 W Bowery St	19 W8XAE	157.53	Mf
Akron Ohio	19 W8XAE	157.53	Mf
Dark Cab Co 120 N State St	6 W9XNRQ	157.53	Mf
Belvidere Ill	6 W9XNRQ	157.53	Mf
Dark's 52 E Blackwell St	2 W2XUJ	157.53	Lf
Dover NJ	2 W2XUJ	157.53	Lf
Clearwater Transit Inc 305 S Garden Av	8 W4XMY	157.53	Mf
Clearwater Fla	8 W4XMY	157.53	Mf
Cleveland Auto Club Co 2805 Euclid Av			
Cleveland Ohio			
Flipper Cab Co 251 W Washington St	5 W9XRE	152.27	Bf
Frankford Ind	5 W9XRE	152.27	Bf
Flipper Cab Co 109 W Pecan St	7 W5XVI	157.53	Mf
Sherman Tex	7 W5XVI	157.53	Mf
Soils Transit Co 117 E Grand Av	12 W5XQZ	157.53	Mf
Louis NMex	12 W5XQZ	157.53	Mf
City Taxi & Transportation 124 W Main St	6 W7XKW	157.53	Bf
Lewiston Montana	6 W7XKW	157.53	Bf
Sub Cars 115 Lake St	20 W3XHF	157.53	Bf
Sallsbury Md	20 W3XHF	157.53	Bf
Coach Corp of Freeport State & Douglas Sts	7 W9XDE	157.53	f
Freeport Ill	7 W9XDE	157.53	f
obby's Taxi 56 W Market St	10 W2XZF	157.53	f
Albany NY	10 W2XZF	157.53	f
Columbia Yellow Cab Co Inc 801 Cherry St		157.53	we
Columbia Mo		157.53	we

BROWNING FREQUENCY METERS

Standard in the Communications Services Since 1939 — Constantly Improved to Meet the Needs of Communications Supervisors

MODEL S-4: Hand Calibrated at any 1 to 5 Frequencies between 1.5 and 100 Megacycles



Use the BROWNING model S-4 frequency meter for communications systems operating on frequencies between 1.5 and 100 mc. This meter is calibrated at any number of points from one to five, as required.

So accurate and convenient is this highly perfected design that you can check the frequency of any transmitter within 60 seconds.

Accuracy of $\pm .0025\%$ meets the FCC requirements. Stability is assured by the use of crystal control, an electron-coupled oscillator, and a line voltage regulator. Operates from 110–115 volts, AC or DC.

Precision settings are indicated by a cathode-ray eye that flutters at the beat frequency, and holds steady at resonance. Ear phones can be used to check the frequency of distant transmitters, picked up on a suitable receiver. Each dial division represents approximately 25 cycles at the lower frequencies. You don't have to guess when you use this BROWNING frequency meter.

Rugged construction is intended to withstand years of use in communication service. Weight 15 lbs. Six tubes, plus voltage regulator are furnished.

MODEL S-7: Hand Calibrated at any 1 or 2 Frequencies between 72-76 and/or 152-162 Megacycles

The BROWNING crystal-controlled S-7 frequency meter is intended for communications systems operating in either or both bands between 72–76 and 152–162 mc. It is calibrated at any one or two frequencies within that range. In design, this instrument is similar to the S-4, and it can be used with the same degree of speed and precision in checking mobile and headquarters transmitters.

The accuracy of $\pm .005\%$ meets FCC requirements. By following the simple procedure outlined in the instructions, an accuracy of $\pm .0025\%$ can be achieved.

Visual indication of resonance is provided by a cathode-ray tube that flutters at beat frequency, and holds steady at resonance. Remote transmitters, picked up on a suitable receiver, can also be checked for frequency. At the low end of the 72-mc. band, each dial division represents about 1,000 cycles. The ease with which readings can be made is an important feature of BROWNING frequency meters.

Operates on 110–115 volts AC or DC. The weight is 15 lbs. Six tubes plus voltage regulator are provided.



MODEL S-5: Hand Calibrated at any 1, 2, or 3 Frequencies between 30 and 500 Mc.



The BROWNING S-5 meter, accurate to $\pm .0025\%$, is suitable for all standard and special services on 30 to 500 mc. The crystal, contained in a temperature-controlled oven, is accurate to $\pm .001\%$. The electron-coupled oscillator is temperature compensated, and a line-voltage regulator is built into the meter.

If desired, the panel, $8\frac{3}{4}$ by 19 ins., can be rack mounted. It is not necessary to bring the mobile

transmitters to the location of the meter. Signals can be picked up on a receiver to which the meter is coupled. The meter is then tuned for zero beat. An easy-reading scale of 5,000 divisions is operated with a precision worm drive. At 30 mc., one division represents about 24 cycles.

Operates on 105–115 volts AC. Weight 35 lbs. Eight tubes and a voltage regulator are supplied.

IMPORTANT: Every communications system should have a BROWNING model RH-10 calibrator, to check any make of frequency meter against Bureau of Standards WWV signals. The RH-10 is standard for this purpose.

**BROWNING
LABORATORIES, INC.**

750 Main Street, Winchester, Mass.

In Canada, Address:

MEASUREMENT ENGINEERING, Ltd.

Arnnprior, Ontario

BROWNING LABORATORIES, Inc.
750 Main St., Winchester, Mass.

Please send me technical details and prices on the following Browning precision products:

- ☐ S-4 Frequency Meter
☐ S-7 Frequency Meter
☐ S-5 Frequency Meter

- ☐ WWV Frequency Calibrator
☐ Laboratory Oscilloscope
☐ FM and FM-AM Tuners

Name.....

Address.....

Company Connection.....

*Something NEW
Has been added*

3 Half Waves in Phase Instead of 2

By adding an additional half wave dipole to its well-known beacon antenna, the Workshop has stepped up the power gain from $2\frac{1}{2}$ to $3\frac{1}{2}$ times that of the ordinary coaxial dipole.

Other new design features include a new molded fiberglass housing for greater strength, less weight, and lower operating losses.

Design Highlights

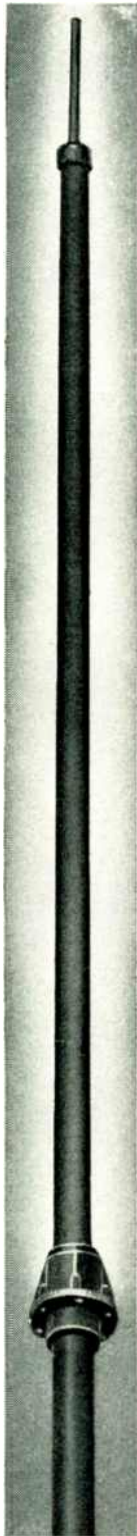
- Low angle of radiation concentrates energy on the horizon.
- Symmetrical design makes azimuth pattern circular.
- Can be fed with various types of transmission lines. Special fittings are available for special applications.
- Entirely enclosed in non-metallic housing for maximum weather protection.
- Designed specifically for 152-162 mc. with a low SWR over the band.

Available for immediate delivery through authorized distributors or your equipment manufacturer.

— THE —
**WORKSHOP
ASSOCIATES**
INCORPORATED

Specialists in High-Frequency Antennas

**66 NEEDHAM STREET
Newton Highlands 61, Mass.**



PAT. APP. FOR

TRUCKS, BUSES, TAXIS — Continued

Columbus Green Cabs Inc 307 S 6th St		
Columbus 15 Ohio	56 W8XNR	157.53 MF
Combined Cab Service Inc 237 Sherman Av NW	250 W8XDJ	157.53 f
Washington DC		
Commercial Cab Co Inc 2923 E 95th St		
Chicago Ill	28 W9XVL	157.53 LF
Community Cab Co 7320 Wisconsin Av		
Bethesda Md	25 W3XNK	157.53 RF
Community Transit Co 15 N Main St		
Helena Montana	5 W7XLL	157.53 MF
Coning's Elec App Serv Co 114 N Harrison St		
Eaton Ohio	5 W8XOB	152.15 RF
State of Conn 100 Washington St		
Hartford Conn	1 W1XFF	2.455 a
State of Conn 165 Capitol Av		
Hartford Conn	1 W1XHX	2.455 a
Cook's Cab Service 110 Small St		
Salesbury Md	20 W3XHB	157.53 MF
Coop Cab Co Inc 1318 Bway		
Columbus Ga	100 W4XAI	157.53 MF
Corvallis Taxi Serv 213 N 4th St		
Corvallis Ore	12 W7XMS	157.53 MF
Courtesy Cab Co 219 Ocean Av		
Laguna Beach Calif	5 W6XWN	157.53 RF
Courtesy Cab Co 227 W Main St		
W Frankfort Ill	7 W9XDT	157.53 RF
Courtesy Cabs 11 San Marcus Ct		
Santa Barbara Calif	20 W6XYH	157.53 RF
Craig Cab Co Inc 605 S Mullberry St		
Muncie Ind	16 W9XOE	157.53 LF
Crescent Motors Inc 920 Wilmer Av		
Anniston Ala	18 W4XRB	157.53 RF
Crescent Motors Inc 507 W Clinton St		
Huntsville Ala	18 W4XRD	157.53 RF
Crescent Motors Inc 709 1st Av		
Gadsden Ala	28 W4XRF	157.53 RF
Cromwell 6200 Taxi Serv 14 RR Av		
Middletown NY	25 W2XVM	157.53 MF
Crump Bros Cab Co 212 E Houston		
Sherman Tex	15 W5X1DZ	157.53 RF
Cubby's Taxi 336 State St		
Ogdenburg NY	9 W2XNF	157.53 MF
Cunningham Taxi Co 404 Weatherly St		
Borger Tex	10 W5XTF	157.53 MF
C & Y Cab Co 522 Robert St		
Fort Atkinson Wis	2 W9XCV	157.53 MF
Dallas Taxi Co 407 Washington St		
The Dallas Ore	10 W7XLT	157.53 MF
D & C Cab Co 44 Bway		
Hornell NY	5 W2XVZ	157.53 LF
Dan's Taxi Serv 826 4th St		
San Rafael Calif	10 W6X1Q	157.53 MF
Danville Viet Cab Co 39 S Vedillon St		
Danville Ill	10 W9XQB	152.27 MF
Geo Wm Davidson 103 Prairie St		
Ottawa Ill	1 W9XYB	152.15 Ba
Davis Cab Co 142 Randolph Av		
Pulaski Va	10 W4XQJ	157.53 LF
Davis Deluxe Cab Co 625 Hampshire St		
Quincy Ill	10 W9XQF	157.53 RF
Davis Taxi 19 Perkins St		
Gloucester Mass	10 W1XFP	157.53 MF
Day's Quarter Taxi Co 418 15th St		
Columbus Ga	50 W4XZB	157.53 MF
Decatur Transit 301 1st Av		
Decatur Ala	28 W4XME	157.53 MF
Deerfield Packing Corp Seabrook Farms		
Bridgeton NJ	25 W2XHH	157.41 LF
DeLuxe Cab Co 120 S Green		
Ottumwa Iowa	15 W0XER	157.53 MF
DeLuxe Cab 206 Ward Av		
Caruthersville Mo	10 W0XMO	157.53 MF
DeLuxe Cab Co 914 Houston St		
Chattanooga 2 Tenn	41 W4XON	157.53 MF
DeLuxe Cab Co Broad Av		
Albany Ga	20 W4XRB	157.53 MF
DeLuxe Cab Co 210 S Church St		
Jackson 1 Tenn	15 W4XSF	152.27 MF
DeLuxe Cab Co 222 Main St		
La Grange Ga	15 W4XUC	157.53 MF
DeLuxe Cab Co 127 N 7th St		
Nashville Tenn	20 W4XVP	157.53 RF
DeLuxe Cab Co 507 F St		
Eureka Calif	4 W6XYU	157.53 f
DeLuxe Cab Co 1300 N Saginaw St		
Flint Mich	35 W8XIL	157.53 MF
DeLuxe Cab Co 10 1/2 E Main St		
Danville Ill	5 W9XFD	157.53 MF
DeLuxe Taxi Service 207 N Virginia St		
Reno Nev	11 W7XMF	157.53 RF
Desota Sedan Service 1399 Post St		
San Francisco Calif	75 W6XAZ	157.53 MF
Diamond Cab Co 116 Buffalo St		
Johnson City Tenn	12 W4XMR	157.53 MF
Diamond Cab 20 E Peadarilly St		
Winchester Va	10 W4XVT	157.53 MF
Diamond Cab Co 704 Calif Av		
Long Beach Calif	82 W6XKY	157.53 MF
Diamond Cab Co PO Box 107		
Pullman Wash	7 W7XKY	157.53 MF
Diamond Cab Co 609 Trent Av		
Spokane Wash	20 W7XMQ	157.53 GF
Diamond Cab Co 32447 Piper St		
E Detroit Mich	10 W8XOS	157.53 MF
Diamond Cab Co 6501 W 84th St		
Inglewood Calif	15 W6XZD	157.53 RF
Diamond Taxi Inc 15-25 W Third St		
Lowell Mass	30 W1XBG	157.53 MF
Dime Taxi Co 1316 High St		
Alameda Calif	50 W6XBC	157.53 MF
Ernest E Dismore 107 Stanton St		
Ames Iowa	5 W0XKD	157.53 a
Dinuba Cab Co 108 E Tulare St		
Dinuba Calif	15 W6XDO	157.53 MF
Dixie Cab Co 553 Ellis St		
Augusta Ga	18 W4XNZ	157.53 RF
Dixie Cab Co 201 S Elm St		
Denton Tex	10 W5XQP	157.53 MF
Dixie Taxi Service Inc 59 Government St		
Mobile Ala	30 W4XAL	157.53 MF
Dodge Taxi & Bus Co 110 W High St		
Fltja Ohio	11 W8XJN	157.53 LF
Domino Taxi 1110 Avenue K		
Lubbock Tex	10 W5XAT	157.53 RF
Don's Cab Co 733 Bway		
Seaside Ore	4 W7XQZ	157.53 RF
Dore's Taxi Inc 179 North Av		
Plainfield NJ	7 W2XQS	157.53 RF
Doty Cab Co 536 N Parish St		
Jackson Miss	35 W5XSG	157.53 KF
DuBois Cabs Inc 22 Catherine St		
Poughkeepsie NY	20 W2XYL	157.53 LF
Dundalk Cab Assoc Inc 3006 Dunleer Rd		
Dundalk Md	20 W3XHV	157.53 RF
Dunellen Taxi Serv 311 North Av		
Dunellen NJ	12 W3XTE	157.53 MF
E Providence Cab Co Inc 152 Warren Av		
East Providence RI	12 W1XNB	157.53 HF
Economy Cab Co 316 N Oak Av		
Mineral Wells Tex	14 W5XVB	157.53 GF

88 Cab Co 118 E Madison St		
Ottawa Ill	9 W9XNF	157.53 MF
Electronic Equip Co 301 E 5th St		
Fort Worth Tex	1 W5XVM	157.53 RF
Ellington Taxi Serv 1900 Erie St		
N Kansas City Mo	10 W0XLU	157.53 RF
El Monte Taxi Co 133 S Tyler Av		
El Monte Calif	15 W6XMS	157.53 MF
Emery Hotel Taxi Co Inc 22 South Av		
Bradford Pa	10 W3XGB	157.53 WF
Empire Taxi Co 63 Mohawk St		
Cheney NY	4 W2XZN	157.53 GF
Egleston Sq Independent Taxi Co 1630 Wash		
Boston Mass	10 W1XHU	157.53 RF
Epps Cab Co 126 N Angelina St		
Lufkin Tex	7 W5XKQ	157.53 LF
Erie Taxicab Co 117 E 10th St		
Erie Pa	40 W3XGJ	157.53 MF
Escanaba Taxi Service 615 Ludington St		
Escanaba Mich	6 W8XPF	157.53 MF
Everett Sq Taxi 449 Bway		
Everett Mass	8 W1XGX	157.53 RF
Peter J Faber 6085 Newburg Av		
Chicago Ill	1 W9XDM	157.89 RF
Falls Cab Co 107 W Portage Trail		
Cuyahoga Falls Ohio	7 W8X1X	157.53 MF
Farrell's Inc 110 S 5th St		
Manhattan Kans	12 W0XJV	157.53 MF
Fayetteville Checker Cab Co 115 W Center		
Fayetteville Ark	10 W5XTX	157.53 RF
52 Taxi Service 923 Lincoln Av		
Pascagoula Miss	10 W5XJF	157.53 MF
Flinn Tax 21 Puhle Sq		
Greenville Ohio	4 W8XIV	157.53 LF
500 Cab Co 117 N Townsend St		
Ada Okla	5 W5XJI	157.53 f
Flamingo Cab Co 1043 5th St		
Miami Beach Fla	6 W4XLV	157.53 MF
Flushing Main St Taxi Serv 135 40th Rd		
Flushing NY	5 W2XAO	157.53 GF
FM Company 260 Main St		
Great Barrington Mass	4 W1XMB	157.53 HF
Thomas M Ford 1311 Green Ridge St		
Seranton Pa	12 W3XDR	157.53 RF
Port Meade Taxi Serv Hillendale		
Silver Spring Md	15 W3XFT	157.53 RF
Fort Wayne Safety Cab Co 1933 Fairfield Av		
Fort Wayne Ind	40 W9XLM	157.53 f
Fort Wayne Safety Cab Co 325 E Wayne St		
Fort Wayne Ind	76 W9XJV	157.53 MF
44 Cab Co Box 37		
Pine Bluff Ark	15 W5X1I	157.53 MF
44 Cab & Bus Co Inc Cate & Bridge Bds		
Jonesboro Ark	20 W5XKO	157.53 MF
Fountain City Taxi Co 4612 N Bway		
Knoxville Tenn	5 W4XWL	152.27 MF
Four-O-Eight Cab Co 1530 Virginia Av		
Joplin Mo	35 W0XKK	157.53 MF
Fowler Taxicab Co 710 Court St		
New Castle Pa	6 W3XOH	157.53 MF
Fred's Cab Co 109 N Rock Island		
El Reno Okla	10 W5XDT	157.53 LF
Fulton Taxi Co 62 So 1st St		
Fulton NY	3 W2XDF	157.53 RF
Gallagher & Sons 32nd & Walnut Sts		
Philadelphia Pa	3 W3XCR	157.53 AF
Garden Cabs 4954 Whittier Blvd		
E Los Angeles Calif	75 W6XPK	157.53 f
Garden City Cab Co Inc 24 Broad St W		
Savannah Ga	40 W4XYO	157.53 MF
Garfield Cab Co 11 Terhune Av		
Lodi NJ	5 W2XYJ	157.53 LF
Gary Cab Co 754 Washington St		
Gary Ind	15 W9XAJ	157.53 MF
Gelsen Cab & Coach Co 1300 Jefferson St		
Des Plaines Ill	11 W9XQP	157.53 MF
Gene's Taxi 15 Clinton St		
Nashua N H	9 W1XGM	157.53 KF
Geneva Cab Co 311 1/2 W State St		
Geneva Ill	12 W9XTI	157.53 G
George's Radio & Telev Co 816 F St NW		
Washington Dc	20 W3XGR	157.53 RF
II B Gets & Sons 69 1st St SE		
Mason Ohio	10 W8XDH	157.53 LF
Gillis Taxi Co NW Cor Public Sq		
Troy Ohio	10 W8X1K	157.53 LF
GI Cab Co 35 S Mission St		
Wenatchee Wash	10 W7XQL	157.53 MF
GI Taxicab Co Inc 509 E 5th St		
Des Moines Iowa	75 W0XKG	157.53 LF
Eugene H Goebel 935 Pleasant St		
Oak Park Ill	1 W10XG	157.89 MF
Gold Stripe Taxi Co 700 Citizens St Hk Bldg		
Houston Tex	53 W5XKY	157.53 GF
Graham Ambulance Serv 2615 Silver Ridge Av		
Los Angeles 26 Calif	10 W6XYB	157.41 RF
Graham Bros Inc 2000 N Peck Rd		
El Monte Calif	26 W6XLU	157.41 MF
M R Gramling 110 Commerce St		
Fort Worth Tex	40 W5XBE	157.53 RF
Granite Stages 64 Union St		
Peterborough N H	20 W10XEC	43.30 MF
Gray Cab Co Inc 357 Cherry St		
Macon Ga	15 W4XZN	157.53 K
Gray Service Co 268 E Ferry St		
Buffalo 8 NY	10 W2XQG	157.53 FF
Green Bait Taxi 214 S 4th St		
Waco Texas	25 W5XOG	157.53 MF
Green Top Taxi Service 1207 Pacific Av		
Tacoma Wash	8 W7XHW	157.53 MF
Greenville Cab Co 315 E McHee Av		
Greenville SC	12 W4XOB	157.53 RF
Green & White Cab Co 207 E Center		
Pocatello Idaho	8 W7XNA	157.53 MF
Green & White Cab Co 1815 Bway		
Denver Colo	50 W0XJD	157.53 GF
Fred A Green 4 Nepeasing St		
Lapeer Mich	3 W8XQJ	152.27 a
Greyhound Cab 4213 Reisterstown Rd		
Baltimore Md	215 W3XGD	157.53 LF
Greystone Cab Box 888		
Nampa Idaho	3 W7XNE	157.53 KF
Grove Taxi Co 1304 Millin St		
Huntington Pa	10 W2XSU	157.53 MF
Hackensack Taxi Service 7 E Mercer St		
Hackensack NJ	30 W2XKH	157.53 LF
Hamiltons Frozen Food Serv 3211 W Davis St		
Dallas Tex	6 W5XYG	157.41 a
Ham & Merv Taxi 215 Market St		
Alton Ill	10 W9XAG	152.27 MF
Hampton Cab Service 16 Collier St		
Hampton Va	10 W4XSH	157.53 MF
Hanford Taxi Service 108 N Douty St		
Hanford Calif	10 W6XAN	157.53 MF
Harp Bros 18 S Hanover St		
Pottstown Pa	6 W3XCN	157.53 RF
Harrisburg Taxi & Bag Co Strawberry St		
Harrisburg Pa	35 W3XDL	157.53 MF
Harris Taxi 4 Mill St		
Littleton NH	4 W1XLY	157.53 MF
Hatboro Taxi Serv 37 S York Rd		
Hatboro Pa	6 W3XMY	157.53 RF

FM and TELEVISION

TRUCKS, BUSES, TAXIS — Continued

Hathaway Oil Co 501 County St New Bedford Mass	25 W1XGI	157.41	Lf
Haven Cabs 356 Magnolia Av Winter Haven Fla	12 W4XUM	157.53	f
Hawley Cabs Public Sq No 315 Troy Ohio	6 W8XPW	157.53	Rf
Hazle Cab Co 10 E Broad St Hazleton Pa	12 W3XFP	157.53	Mf
M B Healer 115 W Anderson Brownwood Tex	15 W5XDX	157.53	Rf
Hicks Taxi Co 123 S 4th St Quincy Ill	6 W9XUM	157.53	Mf
Donald J Henderson 502 E 7th St Tillamook Ore	5 W7XQJ	157.53	Rf
Henley's Yellow Cab Manatee Av at 10th St Bradenton Fla	14 W4XYZ	157.53	f
Hennessey Taxi Service 244 Westfield Av Elizabeth NJ	14 W2XJN	157.53	Lf
Herbert's Taxi 15 Stowell St St Albans Vt	4 W1XNH	157.53	Rf
H & H Cab Co 11 N Park St Sapulpa Okla	10 W5XUT	157.53	Mf
Hickey Cab Co 2 Fairfield Av Bridgeport Conn	15 W1XEF	157.53	Lf
Highway Radio Inc 1424 16th St Washington 6 DC	200 W9XIQ	43.82	Mf
Highway Radio Inc 1424 16th St Washington 6 DC	100 W9XPK	157.41	Mf
Hillside Terminal Cabs Inc 509 48th St Union City NJ	10 W2XIW	157.53	Lf
Hilltop Cab Co 8 Hillcrest Dr Daly City 25 Calif	5 W6XWK	157.53	Mf
Hilop Taxi 58 Porter St Portsmouth NH	10 W1XJH	157.53	Kf
Harold Holt Aveland Rd Hudson NH	10 W1XJJ	157.53	Rf
Virgin Hodson 2136 Sherman Av North Bend Ore	4 W7XPP	157.53	Rf
Hogan Cab Co 1903 Holladay St Portsmouth Va	25 W4XTI	157.53	Lf
Holmes Taxi 88 North St Catskill NY	5 W2XBP	157.53	Lf
Holyoke Yellow Cab Inc 276 High St Holyoke Mass	10 W1XDM	157.53	Mf
Homestead Cab Co PO Box 759 Homestead Fla	4 W4XAM	157.53	f
Hoots Cab Co 600 Webster St Chillicothe Mo	10 W0XLO	157.53	Mf
Hot Shot Taxi 210 S Main St Carthage Mo	10 W0XLB	157.53	Mf
Hotel Holbe Cab Co 820 Bannock St Boise Idaho	16 W7XIF	157.53	Mf
Howe Motor Co Inc 97 Pleasant St Claremont NH	10 W1XJQ	157.41	Mf
Hub City Taxi Co 107 W Main St Jackson Tenn	10 W4XBJ	157.53	Mf
Hudson Taxi Co 648 Bway Bayonne NJ	5 W2XKX	157.53	Lf
James H Hughes 303 E Tyler St Longview Tex	4 W5XIQ	157.41	Mf
Hurry Cab 127 N 7th St Klamath Falls Ore	13 W7XKS	157.53	Mf
Hutchinson Bus & Cab Co 16 East A St Hutchinson Kans	45 W0XPH	157.53	Lf
Ideal Taxi Co 767 Main St Willimantic Conn	3 W1XJL	157.53	Kf
Univ of Illinois Galesburg Ill	3 W9XDV	152.15	Mf
Indiana Deluxe Cab Co 710 Niles Av South Bend Ind	45 W9XMV	157.53	Mf
Indio Yellow Cab 705 Tlingman Indio Calif	5 W6XN1	157.53	Mf
Intermountain Trans Co 2134 Wyoming St Salt Lake City Utah	20 W7XN1	157.53	Mf
Jacobs Taxi Service 440 S Main St Spring City Pa	10 W3XNP	157.53	Rf
Jared Checker Cab Co 402 E Sullivan Av Kingsport Tenn	10 W4XVA	157.53	Mf
Adam Jaselski 1243 N Avers Av Chicago Ill	10 W9XFD	157.53	Rf
Joe's Taxi 13th & Green Sts Augusta Ga	15 W4XWJ	157.53	Mf
Joe's Taxi 114 E Market St Corning NY	4 W2XVH	157.53	Rf
Jolly Cab Co 110 S 2nd St Memphis 3 Tenn	70 W4XLT	157.53	Mf
Jordan Taxi Co 15 McFarland St Charleston W Va	30 W8XGH	157.53	Gf
June Newt Cutrer 116 1/2 Walnut St Hattiesburg Miss	20 W5XRX	157.53	Mf
June Taxi Service Inc 422 S 7th Ave Mt Vernon NY	10 W2XZJ	157.53	Wf
Kedzie Protective Patrol 6 S Kedzie St Chicago Ill	22 W9XRK	157.41	Lf
Kellogg Taxi 129 Kellogg Av Kellogg Idaho	6 W7XLB	157.53	Mf
A A Kemp 706 3rd Av W Kallispell Mont	7 W7XQT	157.53	a
Kennedy & Sons Detective Ag 1654 NW 19th St Miami Fla	4 W4XVC	152.15	
Kenosha Checker Cab Co 1216 59th St Kenosha Wis	25 W9XTM	157.53	Mf
Kenton Cab Co 133 S Detroit St Kenton Ohio	5 W8XOY	157.53	Ba
Frank Ketter 534 Deerfield Av Highland Park Ill	25 W9XPP	157.53	Lf
Keystone Auto Club 220 S Broad St Philadelphia Pa	75 W3XOB	157.41	Mf
Kimball's Taxi Co 224 S James St Ludington Mich	12 W8XNG	157.53	Mf
Kimble Taxi Service 404 Main St Hooton NJ	6 W2XON	157.53	Lf
Lester Kinabrew Jr 510 W Larkin Athens Tex	10 W4XAU	157.53	Gf
Knoxville Airport Transit 521 E Cumberland Knoxville Tenn	15 W4XXM	152.27	Mf
Konen Cab Co 405 N 5th St Fargo N Dak	15 W0XJF	157.53	Mf
Krump's Taxi 183 Broadway Newburgh NY	10 W2XMI	157.53	Lf
Krege Taxi Service 204 Spencer St Ithaca NY	4 W2XTV	157.53	Rf
Kyle Elam Taxi 323 Austin Av Port Arthur Tex	14 W5XQN	157.53	Lf
Lackawanna Taxi Co 101 S Wash Av Scranton Pa	5 W3XEM	157.53	Mf
Laclede Gas Co 923 N 7th St St Louis Mo	75 W0XIJ	157.53	Mf
LaCrosse City Car Co 309 Rivolt Bldg LaCrosse Wis	24 W9XTV	157.53	Mf
Lafayette Taxi Service 147 Chestnut St Meadville Pa	10 W3XDO	157.53	Mf
LaGrange Cab Co 108 W Burlington Av LaGrange Ill	15 W9XPF	157.53	Mf
Lake Cabs Inc 119 Richmond St Painesville Ohio	10 W8XMG	157.53	Rf
Lakeview Cab 43 N McCamly Battle Creek Mich	12 W8XPJ	157.53	Lf
Lapeer Taxi Co 256 W Genessee St Lapeer Mich	3 W8XQZ	157.53	f

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TRUCKS, BUSES, TAXIS — Continued

Laurel Line Taxi Co 109 Cedar Av	20 W3XNJ	157.53	MI
Scranton Pa	20 W3XNJ	157.53	MI
Laws Funeral Home 29 Federal St	2 W1XGR	157.41	MI
Brunswick Me	2 W1XGR	157.53	MI
Lawson Taxi Co 557 N Columbia	7 W9XUF	157.53	MI
Frankfort Ind	7 W9XUF	157.53	MI
Legard's Taxi Service 245 North St	9 W1XDX	157.53	MI
Bath Maine	9 W1XDX	157.53	MI
Liberal Taxi Co 1 S Lincoln	10 W0XLI	157.53	MI
Liberty Cab Corp	10 W0XLI	157.53	MI
Liberty Cab Co 801 1st Av S	5 W0XHH	157.53	MI
Fort Dodge Ia	5 W0XHH	157.53	MI
Liberty Cab Co 624 Viko St	10 W9XSC	157.53	MI
Vincennes Ind	10 W9XSC	157.53	MI
Liberty Cab Co 111 Lee St	30 W4XWT	157.53	MI
Montgomery Ala	30 W4XWT	157.53	MI
Liberty Cab Corp	60 W9XLB	157.53	MI
Evansville Ind	60 W9XLB	157.53	MI
Limited Cab Co 119 1/2 E College St	25 W0XCS	157.53	LI
Iowa City Ia	25 W0XCS	157.53	LI
Limousine Assoc North 3 Lincoln	40 W7XKQ	157.53	MI
Spokane Wash	40 W7XKQ	157.53	MI
F P Lindley MFD	3 W4XUK	157.53	MI
Powder Springs Ga	3 W4XUK	157.53	MI
Little's Red Cab Co 205 S Wash	4 W9XTP	157.53	MI
Crawfordsville Ind	4 W9XTP	157.53	MI
Logan Cab Co 313 Pearl St	5 W9XMS	157.53	MI
Logansport Ind	5 W9XMS	157.53	MI
Long's Bag Transfer Co 600 Church St	80 W4XON	157.53	MI
Lynchburg Va	80 W4XON	157.53	MI
Longhorn Taxi Co 348 Proctor	10 W5XJO	157.53	MI
Port Arthur Tex	10 W5XJO	157.53	MI
Lorain City Radio Corp 203 9th St	2 W8XFI	157.53	GI
Lorain Ohio	2 W8XFI	157.53	GI
Lorain City Radio Corp 203 9th St	5 W8XHF	157.53	GI
Lorain Ohio	5 W8XHF	157.53	GI
Louisville Taxi & Transf Co 832 W Liberty	63 W4XNV	157.53	RI
Louisville Ky	63 W4XNV	157.53	RI
Lucas Funeral Home 617 N Sylvania	6 W5XYS	157.41	a
Fort Worth Tex	6 W5XYS	157.41	a
Luxor Cab 1461 Pine St	50 W6XCR	157.53	MI
San Francisco Calif	50 W6XCR	157.53	MI
Lyndhurst Cab Service 576 Valley Brook Av	5 W2XNL	157.53	MI
Lyndhurst NJ	5 W2XNL	157.53	MI
Lynn Cab Co 3 Almond St	18 W1XDE	157.53	MI
Lynn Mass	18 W1XDE	157.53	MI
MacComb Cab Co 121 E Carroll St	4 W9XVK	157.53	MI
Macomb Ill	4 W9XVK	157.53	MI
Manitowoc Checker Cab Co 714 Wash St	6 W9XWM	157.53	RI
Manitowoc Wis	6 W9XWM	157.53	RI
Marion Radio Red Cab 473 W Center St	10 W8XLL	157.53	RI
Marion Ohio	10 W8XLL	157.53	RI
Martin Trans Co 113 Beach St	30 W6XSW	157.53	KI
Redwood City Calif	30 W6XSW	157.53	KI
Maryland Drydock Co 1900 34th St	26 W3XES	157.41	RI
Baltimore Md	26 W3XES	157.41	RI
Mather's Taxi 78 E Commerce St	6 W2XOZ	157.53	LI
Bridgeton NJ	6 W2XOZ	157.53	LI
H C Mattes 6116 N Knox Av	2 W10XEQ	157.80	RI
Chicago Ill	2 W10XEQ	157.80	RI
G E Mattes 368 Main St	9 W1XHB	157.53	MI
Greenfield Mass	9 W1XHB	157.53	MI
McConnell's Taxi Service 213 N 9th St	15 W3XFR	157.53	RI
Stroudsburg Pa	15 W3XFR	157.53	RI
Orville S McDaniel 323 S Canyon St	14 W5XMG	157.53	MI
Carlsbad NM	14 W5XMG	157.53	MI
McGill's Taxi Co 240 Sunset Av	6 W4XNL	157.53	RI
Asheboro NC	6 W4XNL	157.53	RI
Medford Taxi Service 321 Salem St	10 W1XGB	157.53	MI
Medford Mass	10 W1XGB	157.53	MI
Media Taxi Service 312 Baker St	15 W3XLY	157.53	MI
Media Pa	15 W3XLY	157.53	MI
Medford Cab Co 104 E Main St	7 W7XRS	157.53	MI
Medford Ore	7 W7XRS	157.53	MI
Merced Taxi Service 1735 K St	10 W6XZF	157.53	RI
Merced Calif	10 W6XZF	157.53	RI
Miami Bottled Gas Inc 1701 NW 7th Av	15 W4XNN	157.41	MI
Miami Fla	15 W4XNN	157.41	MI
Michigan Cab Co 715 River St	10 W8XMJ	157.53	MI
Lansing 3 Mich	10 W8XMJ	157.53	MI
Middletown Taxi Service 16 Kline St	6 W2XIN	157.53	LI
Middletown NY	6 W2XIN	157.53	LI
Midland Taxi Co 143 Gordon	15 W8XSD	157.53	MI
Midland Mich	15 W8XSD	157.53	MI
Mid-Way Cab Corp 10 1/2 Wash St	15 W2XNF	157.53	LI
Mid-Way Cab Corp 10 1/2 Wash St	15 W2XNF	157.53	LI
Poughkeepsie NY	15 W2XNF	157.53	LI
Miller Taxi Service 112 State St	20 W1XJY	157.53	MI
Springfield Mass	20 W1XJY	157.53	MI
Minot Cab Co 100 S Main St	10 W0XNN	157.53	RI
Minot ND	10 W0XNN	157.53	RI
Minute Man Cab 110 Wash St	10 W1XAG	157.53	RI
Warwick RI	10 W1XAG	157.53	RI
Mission Taxi Co 151 W San Fernando St	5 W6XMU	157.53	LI
San Jose Calif	5 W6XMU	157.53	LI
M L Hall Inc 801 S Victory Blvd	15 W6XCN	157.53	RI
Burbank Calif	15 W6XCN	157.53	RI
Mobile Taxi Cab Service 19977 Woodward St	20 W5XQF	157.53	MI
Detroit Mich	20 W5XQF	157.53	MI
Model Taxi Corp 115 S State St	30 W2XVB	157.53	RI
Syracuse NY	30 W2XVB	157.53	RI
Monroe Cab Co 211 Grammont St	5 W5XWK	157.53	RI
Monroe La	5 W5XWK	157.53	RI
Monroe Taxi Service Rt 17	4 W2XND	157.53	LI
Monroe NY	4 W2XND	157.53	LI
Moreland's Ambulance Serv 3363 Imperial Hwy	5 W6XHB	157.41	LI
Lynwood Calif	5 W6XHB	157.41	LI
Morgan Cab Co 445 N Magnolia St	20 W5XZD	157.53	MI
Laurel Miss	20 W5XZD	157.53	MI
Motto Limousine Serv 693 McDonald Av	15 W2XRL	157.41	LI
Brooklyn NY	15 W2XRL	157.41	LI
Motorola Inc 4545 Augusta Blvd	1 W9XMG	157.89	MI
Chicago Ill	1 W9XMG	157.89	MI
Nash Taxi Service 567 Warren Av	10 W1XCI	157.53	MI
Brooklyn Mass	10 W1XCI	157.53	MI
Natchez City Lines Inc 23 Aldridge St	20 W5XTP	157.53	MI
Natchez Miss	20 W5XTP	157.53	MI
National Best Co Inc 60 Broad St	2 W2XQV	27.44	a
New York 4 NY	2 W2XQV	27.44	a
National Bus Commun Inc 141 W Jackson Blvd	133 W9XIS	31.02	MI
Chicago 4 Ill	133 W9XIS	31.02	MI
National Bus Commun Inc 141 W Jackson Blvd	87 W10XEO	43.98	MI
Chicago 4 Ill	87 W10XEO	43.98	MI
Newark Taxi Service 113 E Union St	4 W2XVS	157.53	RI
Newark NY	4 W2XVS	157.53	RI
Newton's Central Taxi Co 1202 Monroe St	10 W2XND	157.53	RI
Endicott NY	10 W2XND	157.53	RI
Neway Taxi Co 125 Woodstock Rd	4 W1XEK	157.53	RI
Southbridge Mass	4 W1XEK	157.53	RI
No Chicago Cab Co 1742 Sheridan Rd	9 W9XLG	157.53	MI
No Chicago Ill	9 W9XLG	157.53	MI
Northampton Cab Service 971 Main St	5 W3XMW	157.53	RI
Northampton Pa	5 W3XMW	157.53	RI
North Kansas City Cab 216 E Armour	15 W6XJJ	157.53	MI
North Kansas City Mo	15 W6XJJ	157.53	MI
Northland Lines 118 N First St	6 W8XQH	157.53	MI
Ishpeming Mich	6 W8XQH	157.53	MI
North Side Taxi Serv 40 Bridge St	3 W2XNJ	157.53	LI
Corning NY	3 W2XNJ	157.53	LI
North Taxi Serv Commercial St	8 W1XGP	157.53	KI
Augusta Me	8 W1XGP	157.53	KI

Northway Cab Co 1233 No High St	50 W8XC8	157.53	L
Columbus Ohio	50 W8XC8	157.53	L
Number 1 Cab Co 925 State St	15 W8XON	157.53	M
Traverse City Mich	15 W8XON	157.53	M
G P Nyman 823 N Main St	2 W9XVH	157.53	M
Princeton Ill	2 W9XVH	157.53	M
Oakland Taxi Co 1243 33rd Av	50 W6XRD	157.53	M
Oakland Calif	50 W6XRD	157.53	M
Oakwood Taxi Co 116 Lagrange St	40 W8XNG	157.53	L
Grand Rapids Mich	40 W8XNG	157.53	L
C E O'Dell 118 Michigan Av	3 W8XFL	157.53	L
Ablion Mich	3 W8XFL	157.53	L
Ohio State Dept of Hways 63 S Front St	157.53	a	
Columbus Ohio	157.53	a	
OK Cab Inc 1032 Minnesota Av	20 W8XHW	157.53	M
Kansas City 14 Kans	20 W8XHW	157.53	M
Oliver Taxi & Amb Serv 14th & Pacific	15 W7XIU	157.53	M
Takoma Wash	15 W7XIU	157.53	M
O'Malla & Son Taxi Co 613 Hickory St	3 W0XNH	157.53	L
Iowa Falls Ia	3 W0XNH	157.53	L
121 Cab Line 600 Commercial Av	12 W9XVD	157.53	M
Calro Ill	12 W9XVD	157.53	M
159 Taxi 129 E Water St	10 W5XUD	157.53	M
Santa Fe NM	10 W5XUD	157.53	M
Orange Checker Cab Co 59 W Temple St	75 W7XMW	157.53	R
Salt Lake City Utah	75 W7XMW	157.53	R
Oregon City Taxi Serv 802 5th St	5 W7XQF	157.53	R
Oregon City Ore	5 W7XQF	157.53	R
Orndorff Taxi 210 S Queen St	4 W8XMS	157.53	M
Martinsburg W Va	4 W8XMS	157.53	M
Owl Taxi 124 Court St	10 W2XPB	157.53	L
Hamhamton NY	10 W2XPB	157.53	L
Owl Taxi 88 Lincoln St	7 W6XUJ	157.53	a
Santa Cruz Calif	7 W6XUJ	157.53	a
Owl Taxi 114 N Center St	5 W7XON	157.53	L
Casper Wyo	5 W7XON	157.53	L
Owl Taxi Co 974 Monterey St	4 W6XMB	157.53	M
San Luis Obispo Calif	4 W6XMB	157.53	M
Owl Taxi Serv 1054 Bond St	8 W7XQV	157.53	M
Bent Ore	8 W7XQV	157.53	M
Owl Taxi Corp 250 50th St	10 W6XOF	157.53	L
Richmond Calif	10 W6XOF	157.53	L
Owyhee Cab Co 105 S 9th St	6 W7XNW	157.53	M
Boise Idaho	6 W7XNW	157.53	M
Pacific Taxi Inc 421 W Main St	20 W4XRU	157.53	L
Charlottesville Va	20 W4XRU	157.53	L
Pacific Laundry Co Ltd 932 Chapin St	20 K6XVC	157.53	R
Honolulu Terr of Hawaii	20 K6XVC	157.53	R
Packard Auto Taxi Co 919 Church St	20 W3XEH	157.53	M
Easton Pa	20 W3XEH	157.53	M
Packard Taxi Co 210 W 6th St	10 W9XNQ	157.53	R
Bloomington Ind	10 W9XNQ	157.53	R
Pacific Cab's Consolidated Taxi 201 S 5th St	30 W4XSD	157.53	M
Paducah Ky	30 W4XSD	157.53	M
Pallid Taxi 308 Main St	15 W2XJK	157.53	L
Beacon NY	15 W2XJK	157.53	L
Parmont Cab Co 32 Water St	10 W2XJK	157.53	L
Stapleton Staten Isl NY	10 W2XJK	157.53	L
Park Cab 9 E Bway	6 W7XRO	157.53	M
Butte Mont	6 W7XRO	157.53	M
Parks Cab Co Inc 5919 S State St	5 W9XYD	157.53	M
Chicago Ill	5 W9XYD	157.53	M
Park's Taxi Serv 420 N Mill St	4 W9XZE	157.53	M
Pontiac Ill	4 W9XZE	157.53	M
Patton's Inc 116 E 7th St	35 W5XJM	157.53	G
Austin Tex	35 W5XJM	157.53	G
Paul's Taxi 265 S Garey Av	10 W6XOD	157.53	M
Pomona Calif	10 W6XOD	157.53	M
Paul's Cab 221 N Cuyler	12 W5XBK	157.53	M
Pampa Tex	12 W5XBK	157.53	M
Philadelphia St Hosp Southampton Rd	2 W3XLK	152.15	M
Philadelphia 16 Pa	2 W3XLK	152.15	M
People's Cab Co 806 Jones Law Bldg	100 W3XHI	157.53	M
Pittsburgh 19 Pa	100 W3XHI	157.53	M
People's Cab & Baggage Co 809 S Main St	100 W5XJQ	157.53	M
Tulsa Okla	100 W5XJQ	157.53	M
Peoples Cab & Bag Co 1206 Garrison Av	30 W5XWN	157.53	M
Fort Smith Ark	30 W5XWN	157.53	M
Peoples Central Cab Co 423 Ferry St	12 W9XQY	157.53	M
Lafayette Ind	12 W9XQY	157.53	M
Peoria Cab Corp 607 Franklin St	20 W9XKD	157.53	M
Peoria Ill	20 W9XKD	157.53	M
Pete's Safe-Way Cab Inc 19 S 5th St	20 W9XLS	157.53	L
Richmond Ind	20 W9XLS	157.53	L
Pete's Taxi 30 N Brooks St	5 W7XOZ	157.53	RI
Sheridan Wyo	5 W7XOZ	157.53	RI
Phoenix Taxi Serv Paradise & Chester Av	15 W3XIL	157.53	RI
Phoenixville Pa	15 W3XIL	157.53	RI
A Picken 7 Water St	1 W10XAJ	157.77	RI
Hoston 9 Mass	1 W10XAJ	157.77	RI
Pinney Branch Cab Co 1001 Flower Av	20 W3XFW	157.53	RI
Takoma Md	20 W3XFW	157.53	RI
Pioneer Holding Co 717 6th Av S	65 W0XGR	157.53	M
Minneapolis Minn	65 W0XGR	157.53	M
Plainfield Cab Co 4601 W 50th St	10 W0XNM	157.53	RI
Mission Kan	10 W0XNM	157.53	RI
Pollard Taxi Corp	30 W4XPW	157.53	L
Roanoke Va	30 W4XPW	157.53	L
Powell Taxi Co 62-55 N State St	35 W3XGN	157.53	RI
Wilkes-Barre Pa	35 W3XGN	157.53	RI
Powell's Garage & Wrecker Serv Milwaukee	7 W4XQE	152.15	AT
Columbia SC	7 W4XQE	152.15	AT
Public Cab Co 1524 S 18th St	8 W9XVB	157.53	RI
Newcastle Ind	8 W9XVB	157.53	RI
Public Service Taxi 62 Burd St	9 W2XKF	157.53	L
Nyak NY	9 W2XKF	157.53	L
Public Cab Co 1265 Acoma St	40 W0XMK	157.53	L
Denver Colo	40 W0XMK	157.53	L
Quarter Cab Inc 120 Johnson Park	10 W2XCU	157.53	M
Buffalo NY	10 W2XCU	157.53	M
Quick Service Cab Co 302 N Madison St	20 W9XQJ	157.53	M
Bloomington Ill	20 W9XQJ	157.53	M
Quick Service Taxi Co 741 N New St	20 W8XLU	157.53	M
Allentown Pa	20 W8XLU	157.53	M
Radio Cab Co 131 N Arkansas Av	20 W2XGV	157.53	L
Atlantic City NJ	20 W2XGV	157.53	L
Radio Cab Co 343 Cookman Av	20 W2XOE	157.53	L
Ashbury Park NJ	20 W2XOE	157.53	L
Radio Cab Co 800 Church St	20 W4XMW	157.53	L
Lynchburg Va	20 W4XMW	157.53	L
Radio Cab Co 216 E Olas Blvd	5 W4XNP	157.53	AT
Fort Lauderdale Fla	5 W4XNP	157.53	AT
Radio Cab Co 3150 Woodward Av	60 W8XGB	157.53	M
Detroit Mich	60 W8XGB	157.53	M
Radio Cab Co 1007 1st St S	15 W0XHD	157.53	M
St Cloud Minn	15 W0XHD	157.53	M
Radio Cab Co 117 S Fayette St	10 W8XMA	157.53	M
Beckley W Va	10 W8		



POLICE



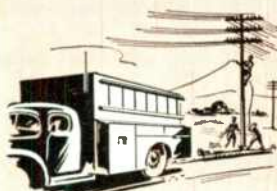
FIRE



TAXIS



BUSSES



UTILITIES



TRUCKING



STOP

**Wasting Minutes!
Wasting Mileage!
Wasting Money!**

Equip Your Fleet with Federal's MOBILE 2-WAY FM RADIO TELEPHONE

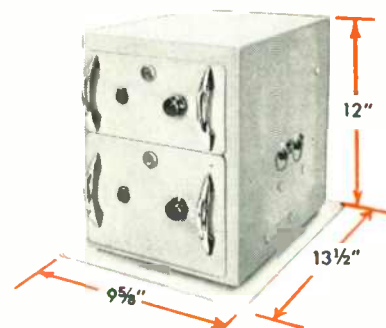
What do you do when you want to get in touch with one of your drivers while he's on the job? And how can he contact you? Without mobile radio, a moving vehicle is practically isolated from all contact with the outside world—and any other method of relaying messages between cars and headquarters wastes time and mileage, and costs plenty of money!

Now, with Federal's Mobile 2-way FM radio, you can keep in instant touch with any car, at any time,—for dispatching, re-routing, checking up on any job. The added efficiency of completely coordinated operation will save the cost of the radio equipment many times over!

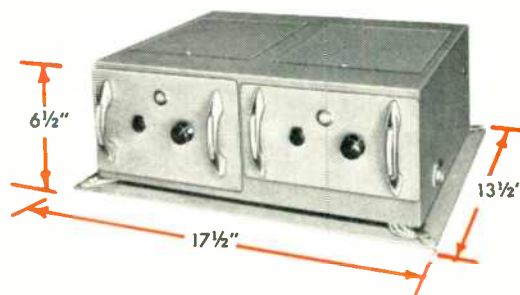
Of course, the return on the investment depends on the equipment used—its operating economy, service life and maintenance cost. And that's where Federal's high standards of quality and workmanship can pay long-term dividends. Before you select your mobile radio equipment, check these outstanding features. Write to Federal for complete information. Dept. 1620.

FEDERAL FEATURES

- **Effective Squelch Action**—receiver muted until called.
- **Low Current Drain**—receiver standby, 5.0 amp. transmitter standby, 30 to 44 Mc, 2.1 amp; 152 to 162 Mc, 0.415 amp.
- **Small Size**—less than one cubic foot
- **Interchangeable Units**—transmitter and receiver sections slide out for fast servicing
- **Low Maintenance Expense**—highest quality components throughout
- **Single Cable**—from dashboard control to transmitter-receiver unit.



TRY THESE FOR SIZE—choice of vertical or horizontal arrangement for most efficient use of available mounting space.



Federal Telephone and Radio Corporation

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

In Canada: —Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: —International Standard Electric Corp. 67 Broad St., N. Y.

EXTRA Listening Pleasure From Any Radio



FM RECEPTOR

With The
Meissner

• The thrill and incomparable beauty of FM reception is available to all with the Meissner model 8C FM receptor. A simple connection to any present AM radio . . . and the full scale fidelity of FM reception, unbelievably free from static, interference or fading, is brought to the listener as only the quality of Meissner skill can produce it. See and hear the new MEISSNER — there is nothing like it! Retail Price . . . \$57.50.

• New FM Band, 88 to 108 Mc. • Audio Fidelity, flat within plus or minus 2 db. from 50 to 15,000 CPS • Audio Output, 3 volts R. M. S. at minimum useable signal input, 30% modulation. • For greater signal inputs, output voltages as high as 15 volts R. M. S. obtained without distortion. • Power Supply, 105 to 125 volts, 50 or 60 cycle AC. Consumption, 35 watts • Tube Complement, 2 type 6AG5, 2 type 6BA6, 2 type 6C4, 1 type 6AL5 and 1 type 6X5GT/G

MEISSNER MANUFACTURING
DIVISION OF MAGUIRE INDUSTRIES, INC.
MT. CARMEL, ILL., U. S. A.

TRUCKS, BUSES, TAXIS — Continued

Seattle Farwest Service Corp 1814 7th Av	157.53	MI
Seattle 1 Wash	100 W7X1Q	
Seattle Mobile Radio Serv 5035 26th Av S	157.53	FI
Seattle Wash	32 W7XKK	
Service Cab Co 113 Madison St	6 W9XWF	157.53 MI
Savanna Ill	5 W9XFB	157.53 BI
Service Cab Co & ER Walting Rm Main St	17 W8XGR	157.53 LI
77 Taxi Co 3 N Verity Pkwy	8 W8XIT	157.53 LI
Middletown Ohio	4 W8XIBZ	157.53 MI
707 Cab & Bus Co 315 Plum St	5 W9XVK	157.53 WI
Red Wing Minn	20 W8XOH	157.53 MI
777 Cab Co Ryan Hotel	25 W2XTY	157.53 MI
Grand Forks ND	4 W6XMX	157.53 RI
Sheboygan Cab Co 936 N 8th St	10 W7X10	157.53 MI
Sheboygan Wis	5 W8XFE	157.53 MI
Shore Cab Co 18701 Lake Shore Blvd	15 W4XZH	157.53 MI
Euclid Ohio	3 W1XEW	157.53 MI
Shore Yellow Cab Co 2336 Pacific Av	12 W5XSV	157.53 MI
Atlantic City NJ		
Signal Trucking Serv 3754 E. 26th St		
Los Angeles Calif		
Silver Streak Cab Co 311 3rd St		
Lewiston Idaho		
Silverton Cabs 7134 Montgomery Av		
Silverton Ohio		
Silver Top Cab Co 22 Church St		
Selma Ala		
Simard Taxi Serv 175 Mehanie St		
Leominster Mass		
600 Cab Co 403 2nd Av N		
Columbus Miss		

600 Cab Co 337 S Bway	5 W7XOL	157.53 a
Coos Bay Ore	25 W5X1U	157.53 MI
Stx-Co-Taxi-Checker Cab 120 1/2 Front St	7 W2XVJ	157.53 BI
Hattiesburg Miss	10 W2XPN	157.53 MI
6400 Cabs Inc	3 W6X1O	157.53 LI
Quilting skipwith 26 Smith St	4 W1XLU	157.53 MI
Newburgh NY	5 W1XJW	157.53 RI
Skyline Taxi Co 526 Calif St	22 W6XMM	157.53 AI
Sacramento Calif	6 W1XJC	157.53 MI
Smith Taxi 187 High St	15 W2XWD	157.53 LI
Portland Me	3 W1XMX	157.53 a
Smith's Cab Co 44 Proctor St	6 W2XWQ	157.53 MI
Framingham Mass	6 W1XJW	157.53 RI
Southeast Taxi Co 9017 Long Beach Blvd	22 W6XMM	157.53 AI
Southgate Calif	6 W1XJC	157.53 MI
Spaulding's Taxi 89 Barre St	15 W2XWD	157.53 LI
Montpelier Vt	3 W1XMX	157.53 a
Sperano's Taxi 17 Spring St	6 W2XWQ	157.53 MI
Cosmopolis NY	6 W1XJW	157.53 RI
Brazzbury P Sprague Cor Main & Dover Sts	21 W6XCM	157.53 LI
Meredith NH	8 W1XLM	157.53 RI
Squires Taxi 27 Garfield St	10 W7X1V	157.53 LI
Waverly NY	6 W7XOL	157.53 a
S & B Town Taxi 75 Railroad St		
Tralntree Mass		
St Louis City Cab Co 8655 Maryland Av		
Clayton Mo		
Stag Taxi 478 High St		
W Medford Mass		
Star's Taxi 1265 Willamette		
Eugene Ore		
Star Cab Co 220 W Bonneville St		
Pocatello Idaho		

Star Cab Co 100 W Central St	15 W4XYW	157.53 MI
Moultrie Ga	12 W8XQI	157.53 MI
Star Cab Co 976 Ruffner St	175 W5X1W	157.53 MI
Birmingham Mich	15 W5XJW	157.53 RI
Star Taxi Co 302 La Branch Av	40 W5XJY	157.53 MI
Houston Tex	3 W6XGN	157.53 MI
Star Taxi Co 100 5th St	3 W1XBW	157.53 MI
Orange Tex	10 W8XNP	157.53 MI
Star Taxi Co 636 Park St	15 W8X1N	157.53 MI
Beaumont Tex	3 W7XPL	157.53 RI
Station Wagon Taxi 4201 W 45th St	6 W9XWB	157.53 MI
Minneapolis Minn	2 W8XLC	157.53 MI
Stedman's Taxi Serv Elmwood Hotel Main St	3 W4XYJ	157.53 BI
Waterville Me	30 W3XNI	157.53 RI
Steel City Taxi Co 478 W Federal St	5 W1XNT	157.53 KI
Yonastown Ohio	99 W6XOB	157.53 WI
S Doyle Inc 20 7th St S	114 C Santa Monica	157.53 MI
Fargo ND	25 W6XTB	157.53 MI
R E Stidham 1010 S Tower St	15 W6XTD	157.53 I
Centralla Wash	24 W6XTF	157.53 MI
Stoner Cab Co 100 W Berry St	30 W6XTH	157.53 BI
Greencastle Ind	7 W6XTJ	157.53 I
Stringer's Vet Cab Co 2644 Lincoln Way	18 W7XJW	157.53 I
Ames Ia	24 W7XJY	157.53 I
Stuart Gardens Cabs 1835 Wiekham Av	15 W7XKB	157.53 I
Newport News Va	6 W1XHD	157.53 LI
Suburban Cab Co Wisconsin & Western Aves	35 W8XNT	157.53 MI
Chevy Chase Md	76 W8XHP	157.53 MI
Sun Cab Co 34 Court St	55 W2XPF	157.53 BI
Auburn Me	5 W7XNQ	157.53 I
Tanner Motor Livery Ltd 320 S Beaudry St	50 W8XHF	157.53 MI
Los Angeles Calif	10 W8XJH	157.53 MI
Tanner Motor Livery Ltd 114 C Santa Monica	2 W1XLB	157.53 a
Santa Monica Calif	13 W2XLC	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	15 W7XMY	157.53 MI
Los Angeles Calif	1 W9XNB	151.41 MI
Tanner Motor Livery Ltd 910 Front St	10 W9XBN	157.53 MI
Sun Diego Calif	20 W5XHI	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	215 W4XKD	157.53 MI
Los Angeles Calif	10 W2XHV	157.53 LI
Tanner Motor Livery Ltd 320 S Beaudry St	20 W4XLN	157.53 MI
Los Angeles Calif	4 W2XKZ	157.53 LI
Tanner Motor Livery Ltd 320 S Beaudry St	6 W2XND	157.53 LI
Los Angeles Calif	5 W8XHU	157.53 I
Tanner Motor Livery Ltd 320 S Beaudry St	12 W6XSR	157.53 KI
Los Angeles Calif	3 W6XRD	157.53 a
Tanner Motor Livery Ltd 320 S Beaudry St	10 W8XFB	157.53 MI
Los Angeles Calif	20 W1XGD	157.53 BI
Tanner Motor Livery Ltd 320 S Beaudry St	10 W1XGK	157.53 GI
Los Angeles Calif	4 W2XRP	157.53 BI
Tanner Motor Livery Ltd 320 S Beaudry St	4 W1XGT	157.53 BI
Los Angeles Calif	10 W8XLM	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	12 W2XOG	157.53 LI
Los Angeles Calif	10 W1XJD	157.53 BI
Tanner Motor Livery Ltd 320 S Beaudry St	14 W2XJL	157.53 LI
Los Angeles Calif	400 W5XMK	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	35 W5XJB	157.53 FI
Los Angeles Calif	15 W8XQW	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	15 W7XPH	157.53 MI
Los Angeles Calif	10 W8XED	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	5 W9XWQ	157.53 MI
Los Angeles Calif	8 W8XNV	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	50 W5XVR	157.53 BI
Los Angeles Calif	2 W6XAJ	157.53 LI
Tanner Motor Livery Ltd 320 S Beaudry St	10 W5XKZ	157.53 MI
Los Angeles Calif	6 W9XCY	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	20 W4XSI	157.53 MI
Los Angeles Calif	75 W4XZR	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	40 W7X1Y	157.53 MI
Los Angeles Calif	35 W6XRI	157.53 MI
Tanner Motor Livery Ltd 320 S Beaudry St	30 W6XLI	157.53 MI
Los Angeles Calif	7 W1XNF	157.53 GI

Over 90% OF NEW MOBILE TRANSMITTER DESIGNS USE **HYTRON**

THE ORIGINAL INSTANT-HEATING TUBE



HY69 — the original instant-heating tube.

Because they fill a real need for conserving filament power, Hytron instant-heating tubes are in. Yes, the 2E25, 2E30, HY69, HY1269, and 5516 are in the new mobile transmitter designs of many famous friends—too many to thank in this small space. The 2E25 and 2E30 also appear on the Army-Navy Preferred List. Why so popular? With no standby current, battery drain can be cut to 4% of that with cathode types—attainable power output and range increase. Potentials of rugged filaments are centered for battery operation. Beam pentode versatility simplifies the spares problem—one type can power all stages. Join the leaders. If you build mobile equipment—for land, sea, air—put Hytron original instant-heating, easy-on-the-battery tubes on *your* preferred list.



Bendix MRT-3A, 152-162 mc f-m taxicab transmitter uses 2E30's generously.



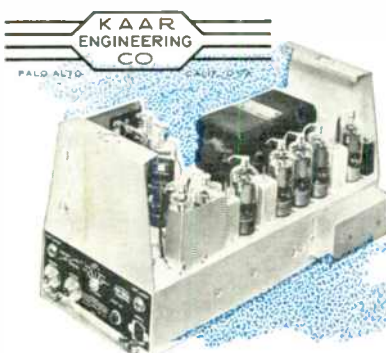
Federal's 25-watt, vhf Model FMTR-25-VC. Note emphasis on 2E30 and 5516.



Harvey Laboratories chose 2E30's, 5516's for its Model 542 f-m transmitter.



Jefferson-Travis Model 351, 35-watt marine radio-telephone employs HY69's.



Kaar FM-50X features 2E25, HY69 throughout. Hytron instant-heating tubes since 1939.



5516's power both driver-doubler and final of Motorola's Model FMTR-30D.



WRITE FOR FREE NEW DATA SHEETS:
2E25, 2E30, HY69,
HY1269, 5516.

SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921

HYTRON

RADIO AND ELECTRONICS CORP.

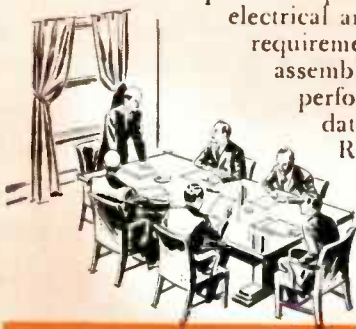


MAIN OFFICE: SALEM, MASSACHUSETTS

The Best Resistors Are Not Enough

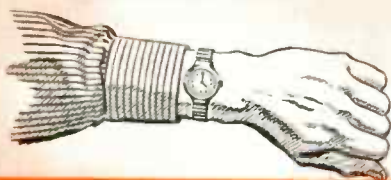
The most complete line of high quality resistors is not enough. IRC considers sincere service—cooperative development work, unbiased recommendations, on time deliveries, genuine help in emergencies and friendly follow thru also vital in meeting advancing demands of industry.

The RESISTOR ANALYSIS COUNCIL is a natural development of this concept. Sponsored by IRC, and established to provide experienced technical aid on your resistor problems—electrical and mechanical. Working together on your specific requirements, confidential analysis may disclose ways to cut assembly costs, eliminate expensive "specials" or improve performance. You may obtain this counsel by sending available data on your resistor problem to the RAC at—International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa.



Resistor Analysis Council

A new IRC industry service. Composed of IRC electrical and mechanical engineers plus production specialists, the RAC—Resistor Analysis Council operates as consultant to engineers and designers. Provides confidential analysis of resistor requirements—helps solve electrical, mechanical and cost considerations. RAC's industry knowledge is sufficiently broad that recommendations need not be confined to IRC products. Consult the Resistor Analysis Council on your present or anticipated resistor problems.



On Time Deliveries

Purchasing Agents and material control executives rely upon IRC's "on time" deliveries. They know that regardless of a product's high quality, assembly line problems are a natural consequence when delivery schedules aren't met. IRC delivers "on time"—also maintains factory stock piles of most popular resistor types and ranges assuring you of real assistance in emergencies.

SERVICE IS VITAL



Complete Line

Only IRC produces such a wide range of resistor types. All your requirements can be readily supplied from one source. Manufacturing all types, IRC's recommendation on the proper resistor for your product is unbiased. For over two decades IRC has concentrated its engineering and manufacturing talent exclusively on resistors. You benefit by this accumulated experience when you specify IRC. Technical Data Bulletins are available on each IRC resistor type.



Industrial Service Plan

Providing speedy "round the corner" deliveries on your small order requirements, IRC's distributor network maintains well-stocked shelves of all standard items. No time lost when you need experimental or maintenance quantities in a hurry. When time means money you profit by competent service from the IRC distributor in your area—write for his name and address.

INTERNATIONAL RESISTANCE COMPANY



IN CANADA: INTERNATIONAL RESISTANCE COMPANY, LTD., TORONTO, LICENSEE

Power Resistors • Precisions • Insulated Composition Resistors • Low Wattage Wire Wounds • Rheostats • Controls • Voltmeter Multipliers • Voltage Dividers • HF and High Voltage Resistors

TRUCKS, BUSES, TAXIS — Continued

Union Square Taxi Co 116 Middle St	18 W1XDC	157.53	Mf
Lewiston Me			
Union Taxi Co 1348 1/2 Hwy	15 W7NPZ	157.53	Bf
Tacoma Wash			
United Cab Co 9 E 12th St	18 W9NKN	157.53	Lf
Anderson Ind			
United Cab Co 620 Monroe St	6 W9NTX	157.53	Mf
LaPorte Ind			
United Cab Co 2323 N 24th St	10 W0XNH	157.53	Bf
Omaha 10 Neb			
United Cab Drivurself Inc	45 W9XJM	157.53	Mf
Rockford Ill			
United Radio Cabs 3159 E Tulare	6 W6XQN	157.53	Mf
Fresno Calif			
University Cab Inc 1384 Mass Av	10 W1XDJ	157.53	Mf
Cambridge Mass			
Urban-Neon Advt Co 1407 49 Tuscarawas St W	3 W8NPPY	157.53	Kf
Canton Ohio			
Valley Cab Co 56 E Huntington Dr	10 W6XCM	157.53	Bf
Arcadia Calif			
Valley Car Service 14723 Aetna St	24 W6XPG	157.53	Mf
Van Nuys Calif			
Valley Coaches Inc 14 9th St	40 W4XUW	157.53	Mf
Augusta Ga			
Vandever Taxi Serv 117 W 4th St	6 W9XOP	157.53	Mf
Mt Carmel Ill			
Vaniska Inc 1 N Wood Av	10 W2XSL	157.53	Mf
Linden NJ			
Veteran Cab Co 221 N Kansas	4 W0XMQ	157.53	Rf
Liberal Kans			
Veterans Cab Assoc 114 Commerce Lane	12 W3XNF	157.53	Rf
Rockville Md			
Veterans Cab Assoc 1560 Eekington Pl NE	50 W3XVF	157.53	f
Washington DC			
Veterans Cab Co 33 E 6th St	6 W8XOF	157.53	Mf
Mansfield Ohio			
Veterans Cab Co 211 S Grove St	4 W9XBZ	157.53	Gf
Elgin Ill			
Veterans Cab Co 173 W Lincoln Hwy	6 W9XNI	157.53	Mf
DeKalb Ill			
Veterans Cab Co 221 W 7th St	10 W5XVE	157.53	Mf
Okmulgee Okla			
Veterans Cab Co 207 N 9th	20 W0XJM	157.53	Mf
Columbia Mo			
Veterans Cab Co 849 State St	5 W0XNB	157.53	Bf
Fort Scott Kans			
Veterans GI Cab Co 245 Pacific Av	15 W6XZB	157.53	Bf
Santa Cruz Calif			
Veterans & Radio Cab Co 120 E 4th St	10 W0XFL	157.53	Mf
Dubuque Ia			
Veterans Taxi Cab Co 1004 E 4th St	60 W5XRM	157.53	Mf
Tulsa Okla			
Veterans Taxi Co 8 Old Post Office Rd	10 W3XLO	157.53	Rf
Silver Springs Md			
Veterans Taxi Serv 57 Rye St	10 W2XYG	157.53	Lf
Paterson NJ			
Veteran Town Cab Co 596 N Chester Av	4 W6XUT	157.53	Ba
Pasadena Calif			
Veterans Transit Corp 433 S Tower St	100 W6XQB	157.53	Mf
Low Angeles Calif			
Veterans Yellow Cab 226 N 4th St	20 W5XOE	157.53	Mf
Muskogee Okla			
Vets Cab Co 35 Lincoln Way W	6 W8XEG	157.53	Mf
Massillon Ohio			
Vets Cab Co 1102 E Douglas	50 W0XFU	157.53	Gf
Wichita Kans			
Vets Cab Service 112 E 1st St	30 W0XKB	157.53	Gf
Hutchinson Kans			
Vet's Cab 606 Market St	5 W3XJX	157.53	Af
Marcus Hook Pa			
Vet's Safe-T-Cab Assoc 38 Pleasant St	3 W1KLD	157.53	Mf
Fall River Mass			
Victory Cab Co Inc 923 S 5th St	40 W4XDL	157.53	Bf
Louisville Ky			
Victory Cab Co 140 W Argonne Dr	10 W0XIZ	157.53	Mf
Kirkwood Mo			
Village Cab Co 747 Madison	42 W9XOM	157.53	Mf
Oak Park Ill			
Virginia Dept of Highways 1221 E Broad St	1 W4XKZ	2 455 a	
Richmond Va			
Vucovich Service 321 N Irwin St	1 W6XWW	157.41 a	
Hanford Calif			
Walsh's Taxi Co 171 S 14th St	4 W2XHR	157.53	Lf
Lindenhurst Ill NY			
Wapleton Cab Co 312 6th St N	10 W0XMY	157.53	Mf
Wapleton ND			
Ware's Taxi Service 615 Park St	6 W4XYS	157.53	Af
Clearwater Fla			
Warren Township Taxi 25046 Van Dyke St	15 W8XPH	157.53	Mf
Centerline Mich			
Warren Veterans Car Assoc 148 Pine St NE	12 W8XMY	157.53	Lf
Warren Ohio			
F E Waterfield 1421 W Lexington	10 W0XNJ	157.53	Kf
Independence Mo			
G J Weems MD	1 W3XCC	157.53	Lf
Huntington Md			
Welsh Cab Co 22325 Nine Mile Rd	5 W8XLY	157.53	Mf
St Clair Shores Mich			
L L Welsh 26 DuMont Pl	21 W2XIJ	157.53	Lf
Morristown NJ			
Western Union Tel Co 60 Hudson St	1 W10XBN	157.05	Lf
New York NY			
Western Union Tel Co 60 Hudson St	1 W10XBO	157.05	Lf
New York NY			
Western Union Tel Co 60 Hudson St	1 W10XBP	157.05	Lf
New York NY			
West Shore Taxi Co Old York Rd	10 W3XHZ	157.53	Nf
New Cumberland Pa			
Wheeler & Nutting Taxi Co 2 Lock St	7 W1XET	157.53	Pf
Nashua NH			
White Cab Service 910 Madison St	3 W9XRV	157.53	Lf
Lake Geneva Wis			
White Cab Co 801 McCormick Av	6 W9XDJ	157.53	Mf
Washington Ind			
White Front Taxi Service PO Box 154	10 W4XNS	157.53	Lf
Raven Va			
White Line Cab Co 112 W Larkin St	2 W5XYD	157.53	Bf
Athens Tex			
White Line Cab Co Benton & Jackson Sts	13 W9XKE	157.53	Mf
Freeport Ill			
White Top Cabs Rt A	8 W4XVK	157.53	Mf
Griffin Ga			
White Top Cab Co 110 N 75th St	2 W5XNK	157.53	Bf
Houston Tex			
White Top Cab Co 555 Auto Hotel	25 W5XFK	157.53	Mf
Jackson Miss			
White Top Cab Co 106 S Madison St	20 W5XZH	157.53	Mf
Camden Ark			
White Top Cab Co 701 Chelsea St	12 W0XHY	157.53	Bf
Kansas City Kans			
Wholesale Supply Co 108 Bway	5 W4XFE	157.53	f
Nashville Tenn			
Wichita Cab Co Inc 728 W Douglas	65 W0XLE	157.53	Mf
Wichita Kans			
C H Wiles MD 58 Huntington St	1 W1XLS	157.41	Lf
New London Conn			
Wilde & Wilde Inc 1861 Hwy	50 W6XQK	157.53	Mf
Fresno Calif			
Willett Co 700 S Desplains St	200 W9XJH	157.53	Rf
Chicago Ill			

YOUR SALES STORY

Will Be HEARD By More "Interested People" * If You Put It On

WCFC in BECKLEY

* People With FM Sets . . . Interested In Keeping Abreast With The Times . . . Want New Products . . . New Facts About The Old



Beckley, the "Smokeless Coal Capital," can be one of your richest markets with the help of WCFC, pioneer FM station in West Virginia. WCFC programming is geared to the needs of the community and is thus able to serve the advertiser better. Write for rate card and complete market data.

The SMOOTH Voice Of The "Billion Dollar" Smokeless Coal Fields
3000 WATTS • 101.3 Mcs. • CHANNEL 267

WCFC

305 Reservoir Road
Beckley, West Va.

P A Williams 101 S Jefferson St	12 W5XBY	157.53	Rf
Mt Pleasant Tex			
Willie's Taxi 213 S Wayne	5 W4XCB	157.53	Bf
Milledgeville Ga			
Wilmington Cab Co 127 W B St	15 W6XMK	157.53	Mf
Wilmington Calif			
Winona Cab Co 126 E 3rd St	5 W0XKY	157.53	Bf
Winona Minn			
Winsky-Fleming 2573 94th Av	3 W6XUB	157.41	f
Oakland Calif			
W T Sistrunk & Co 601 W High St	16 W1XBM	43.78	Mf
Lexington 31 Ky			
Wyandotte Cab Co 3259 Biddle St	5 W8XKM	157.53	Mf
Wyandotte Mich			
Wychwood Cab Co 605 South Av	12 W2KPI	157.53	Mf
Westfield NJ			
Yellow Cab Co of Mo 201 W 14th	15 W0XAA	152.27	f
Kansas City 6 Mo			
Kansas City 6 Mo	W0XCC	152.27	f
Yellow Cab & Bag Co Inc 121 N Kans Av	32 W0XAT	152.27	Mf
Topeka Kans			
Yellow Cab Co 518 N Pine St	15 W0XKQ	157.53	Mf
No Platte Neb			
Yellow Cab Co 7 N 2nd Av	10 W0KBW	152.27	Mf
Marshallsburg Ia			
Yellow Cab Co 206 N 7th	26 W0XCT	152.27	Mf
Lincoln Neb			
Yellow Cab Co 550 7th St	100 W0XDF	152.27	Mf
Des Moines Ia			
Yellow Cab Inc 619 S 20th St	150 W0XPF	152.27	Mf
Omaha Neb			
Yellow Cab Co 611 6th St	15 W0XGU	152.27	Mf
Rapid City 8 Dak			
Yellow Cab Co 105 N Court St	13 W0XGY	152.27	Bf
Ottumwa Ia			

Yellow Cab & Bag Co 313 1/2 Joplin St	30 W0XHQ	152.27	Mf
Joplin Mo			
Yellow Cab Co 210 1st Av N	10 W0XJT	157.53	Mf
Jamestown ND			
Yellow Cab Co 428 Central Av	10 W0XJZ	157.53	Lf
St Dodge Ia			
Yellow Cab Co 109 1/2 W High St Box 214	15 W0XIQ	157.53	Mf
Jefferson City Mo			
Yellow Cab Co 339 N Cedar	3 W0XLY	157.53	Mf
Owatonna Minn			
Yellow Cab Co 212 W Main St	12 W0XMW	157.53	Lf
Cherokee Ia			
Yellow Cab Co 212 1st Av W	5 W0XNF	157.53	a
Newton Kans			
Yellow Cab Co 306 S Lamine	20 W0XSB	157.53	Mf
Sedalia Mo			
Yellow Cab Co 8 Jewel Ct	50 W1XEH	157.53	Gf
Hartford Conn			
Yellow Cab Co 80 Essex St	1 W1XFB	157.53	Hf
Lynnfield Mass			
Yellow Cab Co 550 Park Av	25 W1XFD	157.53	Gf
Worcester Mass			
Yellow Cab Co 291 Bway	20 W2XQN	157.53	Mf
Monticello NY			
Yellow Cab Co 2 Ross St	50 W3XAH	157.53	Gf
Pittsburgh Pa			
Yellow Cab Co Clark & Cherry Sts	12 W3XBM	157.53	Lf
York Pa			
Yellow Cab Co 508 E Preston St	100 W3XBO	157.53	Af
Baltimore 2 Md			
Yellow Cab Co 421 Linden St	40 W3XEX	157.53	Mf
Allentown Pa			
Yellow Cab Co 2nd & Walnut Sts	8 W3XEF	157.53	Mf
Lansdale Pa			

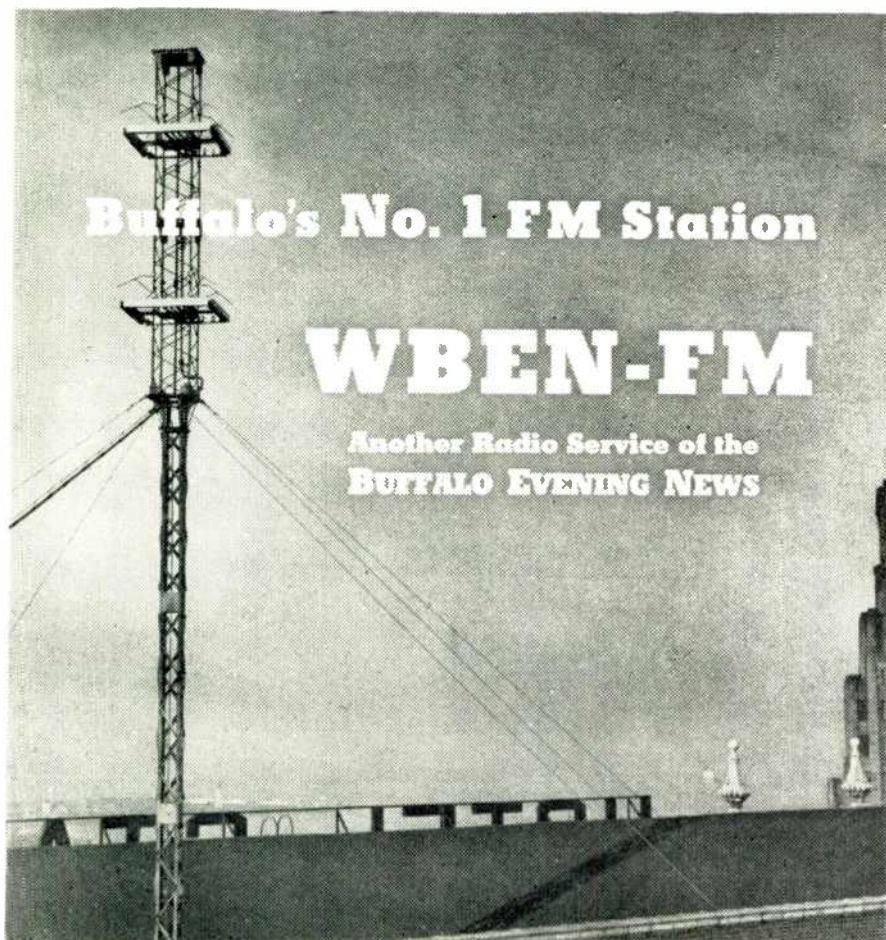
WMRC-FM

GREENVILLE, S. C.

Building the Largest FM Audience in the Carolinas, by Giving the Finest FM Service

With 48.6 kw. of effective radiation on 93.3 mc., WMRC-FM has taken the lead in providing fine programs with powerful signals over the western and central Carolinas and east to Rocky Mount, Goldsboro, Fayetteville, Myrtle Beach, and Charleston, and extending to Bristol and Danville, Va., Knoxville and Johnson City, Tenn., and Atlanta and Athens, Ga. Daily schedule, noon to 9:00 p.m.

Textile Broadcasting Co.
WMRC and WMRC-FM



Buffalo's No. 1 FM Station

WBEN-FM

Another Radio Service of the
BUFFALO EVENING NEWS

TRUCKS, BUSES, TAXIS — Continued

Yellow Cab Co Box 199	30	W3NEJ	157.53	Mf
Chester Pa				
Yellow Cab Co 1505 Race St	50	W3XNP	157.53	At
Philadelphia Pa				
Yellow Cab Co 1801 NY Av NE	100	W3XWN	157.53	Gr
Washington DC				
Yellow Cab Co 1505 Race St	25	W3XWW	157.53	At
Philadelphia Pa				
Yellow Cab Co 509 Inman St	20	W4XAY	152.27	Mf
Cleveland Tenn				
Yellow Cab Co 218 N Collins	15	W4XBD	157.53	Mf
Plant City Fla				
Yellow Diamond Cab Co 77 Wentworth St	35	W4XDD	157.53	Mf
Charleston SC				
Yellow Cab Co 102 S Lafayette St	25	W4XDF	157.53	Rf
Alexandria Va				
Yellow Cab Co 320 St Ann St	40	W4XDH	157.53	Lf
Owensboro Ky				
Yellow Cab Co 7 S Granby St	75	W4XDN	157.53	f
Richmond Va				
Yellow Cab Co Box 371	50	W6XDY	157.53	Bf
Rochester Minn				
Yellow Cab Co 20 Houston St NE	56	W4XLZ	157.53	At
Atlanta Ga				
Yellow Cab Co 45 E Washington St	15	W4XMI	157.53	Rf
Orlando Fla				
Yellow Cab Co 112 W Davis St	35	W4XMT	157.53	Lf
Raleigh NC				
Yellow Cab Co 413-16 Trust Bldg	4	W4XNA	157.53	Lf
Durham NC				
Yellow Cab Co 126 W Court	24	W4XNH	157.53	Mf
Greenville SC				
Yellow Cab Co 317 S Popular St	50	W4XNJ	157.53	Lf
Charlotte NC				
Yellow Operating Co 1048 5th St	50	W4XNR	157.53	f
Miami Beach Fla				
Yellow Cab Co 306 Jefferson Av	25	W4XNT	152.27	At
Memphis Tenn				
Yellow Cab Co 200 Shenandoah Av	50	W4XPO	157.53	Lf
Roanoke Va				
Yellow Cab Co 39 Federal St	12	W4XOQ	157.53	Lf
Madisonville Ky				
Yellow Cab Co 3914 Jefferson Av	20	W4XQ8	157.53	Mf
Newport News Va				
Yellow Cab Co 212-10th Av	5	W4XRH	157.53	Lf
Nashville Tenn				
Yellow Cab 11 W Piccadilly St	8	W4XRO	157.53	Bf
Winchester Va				
Yellow Dot Cab Co 304 W Broad Av	16	W4XRW	157.53	M
Albany Ga				
Yellow Cab Co 121 State St	42	W4XTU	157.53	Mf
Knoxville Tenn				
Yellow Cab Co 152 N Limestone	75	W4XUO	157.53	Lf
Lexington Ky				
Yellow Cab Co Box 513	22	W4XUS	157.53	Mf
Jacksonville NC				
Yellow Cab Co 7th & Virginia	15	W4XUQ	157.53	Mf
Hopkinsville Ky				
Yellow Cab Co 3108 10th Rd N	25	W4XWB	157.53	Bf
Arlington Va				
Yellow Cab Co 817 State St	35	W4XWW	157.53	Mf
Bowling Green Ky				
Yellow Cab Co 315 E Congress St	100	W4XYL	157.53	Mf
Savannah Ga				
Yellow Cab Co 328-13th St	10	W4XYU	157.53	Bf
Ashland Ky				
Yellow Cab Co 100 4th St S	30	W4XZT	157.53	Mf
St Petersburg Fla				
Yellow Cab Co 1110 Av K	10	W5XAO	157.53	Bf
Lubbock Tex				
Yellow Cab Co 524 Murray St	20	W5XIV	157.53	f
Alexandria La				
Yellow Cab Co 1420 26th Av	15	W5XJK	157.53	Mf
Gulfport Miss				
Yellow Cab Co 641 Pearl St	17	W5XLP	157.53	Lf
Beaumont Tex				
Yellow Cab Co 112 1/2 W Central	20	W5XNR	157.53	Gr
Albuquerque NMex				
Yellow Cab Co 637 E South St	5	W5XNT	157.53	Mf
Opelousas La				
Yellow Cab Co 301 W Markham St	6	W5XON	157.53	Lf
Little Rock Ark				
Yellow Cab Co 426 Cypress St	50	W5XON	157.53	Mf
Ablene Tex				
Yellow Cab Co 304 1/2 S Washington	20	W5XOZ	157.53	Mf
El Dorado Ark				
Yellow Cab Co 718 Crockett St	55	W5XPR	157.53	Mf
Shreveport La				
Yellow Cab & Bag Co 216 W Maple	20	W5XPD	157.53	Mf
Enid Okla				
Yellow Cab Co NE Cor Cherry & Perry Sts	8	W5XQD	157.53	Df
Helena Ark				
Yellow Cab Co 215 E Houston St	17	W5XQH	157.53	Mf
Marshall Tex				
Yellow Cab Co 2405 Oak St	20	W5XQU	157.53	Ff
Greenville Tex				
Yellow & Deluxe Cabs 410 S Dewey	10	W5XRH	157.53	Mf
Bartlesville Okla				
Yellow Cab Co 301 Lafayette St	30	W5XRO	157.53	Ff
Baton Rouge La				
Yellow Cab Co				
Killeen Tex	12	W5XNM	157.53	Ba
Yellow Cab & Bag Co 305 S Fillmore	40	W5X8X	157.53	a
Amarillo Tex				
Yellow Cab Co 215 S Main St	20	W5XNZ	157.53	Ff
Paris Tex				
Yellow Cab Co 702 S 1st St	10	W5XUI	157.53	Ff
Temple Tex				
Yellow Cab Co 32 W Twoblk St	25	W5XUW	157.53	Ff
San Angelo Tex				
Yellow Cab Co 111 State Line Av	20	W5XVK	157.53	Mf
Texasarkana Tex				
Yellow Cab Co 403 E Whaley St	20	W5XVT	157.53	Ff
Longview Tex				
Yellow Cab Co 122 Parkinson Av	10	W5XWB	157.53	Mf
Crowley La				
Yellow Cab Co 313 Runnels St	15	W5XZF	157.53	Mf
Hig Spring Tex				
Yellow Cab Service 217 S Los Angeles St	10	W6XAP	157.53	Mf
Anaheim Calif				
Yellow Cab Co 372 Park Av	6	W6XIJ	157.53	Mf
San Jose Calif				
Yellow Cab Co 1177 E Anaheim St	80	W6XLO	157.53	Mf
Long Beach Calif				
Yellow Cab Co 639 13th St	180	W6XNM	157.53	Mf
San Diego Calif				
Yellow Cab Co 35 W 7th St	20	W6XOH	157.53	a
National City Calif				
Yellow Cab Co 1408 W 3rd St	1001	W6XPR	157.53	Mf
Los Angeles Calif				
Yellow Cab Co 245 Turk St	600	W6XPE	157.53	Mf
San Francisco Calif				
Yellow Cab Co 737 16th St	200	W6XPI	157.53	Mf
Oakland Calif				
Yellow Cab Co 248 23rd St	18	W6XQV	157.53	a
Richmond Calif				
Yellow Cab Service 157 Castro St	6	W6XRM	157.53	Mf
Mountain View Calif				
Yellow Cab Co 101 1/2 S Hill St	25	W6XRO	157.53	Mf
Oceanside Calif				

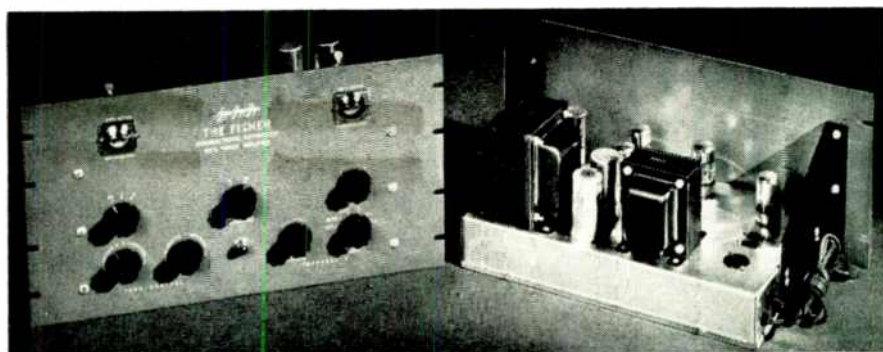
FM AND TELEVISION

TRUCKS, BUSES, TAXI — Continued

Yellow Cab Co Fox Hotel 4th & Main Sts Taft Calif	3 W6NTX	157.53	a
Yellow Cab Co 3755 Market St Riverside Calif	15 W6NNB	157.53	Mf
Yellow Cab Co 1301 18th St Bakersfield Calif	35 W6NYJ	157.53	Mf
Yellow Cab Co 561 4th Av N Twin Falls Idaho	5 W7NHI	157.53	Mf
Yellow Cab Co 111 1/2 S 8th St Klamath Falls Ore	7 W7XLP	157.53	Bf
Yellow Cab Co 321 W 4th St Dayton 2 Ohio	55 W8NMC	157.53	Rf
Yellow Cab Co 247 W Water St Kalamazoo Mich	22 W8NME	157.53	Mf
Yellow Cab Co 264 Prairie St Elgin Ill	19 W9NAE	157.53	Mf
Yellow Cab Co 510 St Louis Av E St Louis Ill	25 W9NCR	157.53	f
Yellow Cab Co 216 Washington St Waukegan Ill	20 W9NQK	157.53	Mf
Yellow Cab Co 99 Pine St Riverside Rd Ill	5 W9NRX	157.53	Mf
Yellow Cab Co 2907 63rd St Kenosha Wis	30 W9NYP	157.53	Wf
Yellow Cab Co 5036 Hohman Av Hammond Ind	26 W9NYH	157.41	Bf
It W Yingling 39 Main St Lockport NY	3 W2NRN	157.53	Bf
Young's Taxi 18 Sullivan St Claremont NH	10 W1NIIQ	157.53	Mf
Zion Taxi 2715 Sheridan Rd Zion Ill	6 W9NWK	157.53	Mf
Zone Cab Co 317 E Market St Warren Ohio	8 W8NIR	157.53	Mf

EXP. UTILITY & INDUSTRIAL

AT & T (Long Lines Dept) 32 Av of Amer New York NY	4 W10XIDZ	153.59	Mf
Arizona-Nevada Constr PO Box 38 Dinuba Calif	6 W6NRU	153.59	Mf
Nr Minkler Cal	W6NRV	153.59	Mf
Nr Seville Cal	W6NRW	153.59	Mf
Arkansas Western Gas Co 28 E Central St Payetteville Ark	15 W5NYL	33.18	Mf
Asbestos Erectors Inc Bound Brook NJ	3 W4NQF	42.98	a
Brown & Root Inc 4300 Calhoun Rd Houston Tex	15 W10XCV	33.18	Lf
Calif Elec Pr Co 3771 8th St Riverside Calif	W6NKT	72.66	Mf
Cedar Park Cemetery PO Box 68 Westwood NJ	10 W2NTL	153.59	Lf
Central Ariz Lt & Pr Co PO Box 2591 Phoenix Ariz	W7XNS	75.50	At
Gila Bend Ariz	W7XNT	72.66	At
White Tank Mnt	W7XNV	75.50	At
Chambers & Garrison 1519 Conn Av Washington DC	6 W10XA1	153.59	Ba
Dallas Pr & Lt Co 515 Park Av Dallas Tex	2 W5NOT	39.98	Mf
R B Doe 11 E Norris Rd Bakersfield Calif	12 KEVW	30.58	Kf
E Texas Salt Water Disp Co PO Box 633 Kilgore Tex	6 W5XYH	37.62	Mf
EWA Plantation Co PO Box 2990 Honolulu Hawaii	20 K6NTU	153.71	Bf
G E Kadane & Sons Hamilton Bldg Wichita Falls Tex	22 W5XWS	33.26	Gr
Gulf Pr Co Pensacola Fla	2 W4XTP	153.71	Mf
Hawaiian Commercial & Sugar Co Honolulu Hawaii	12 K6NAL	153.59	Bf
Hudson Paint & Dec Co Inc 441 Lexington Av New York NY	11 W2XUL	153.59	Lf
Interstate Pet Commun 30 Rockefeller Plaza New York NY	8 W5XWX	37.82	Mf
Kans Gas & Elec Co. Cheney Kans	W9NIB	75.50	f
Atlanta Kans	W9NIB	75.50	f
Strauss Kans	W9NIP	75.50	f
King Farms Co Morrisville Pa	11 W3XDB	156.99	Mf
Latex Construction Co 2707 Fernside St Houston Tex	10 W5XYX	33.18	Mf
Los Angeles Transit Lines 1060 S Broadway Los Angeles Calif	W6XQF	72.26	Lf
Macon Electric Cooperative Macon Mo	2 W6XFI	153.59	Mf
National Steel Corp Welton WVa	8 W8XJ1	153.59	f
Oklahoma Railway Co Oklahoma City Okla	5 W5XKF	—	—
Panhandle East Pipe Line 1221 Balt Av Kansas City Mo	W8XGC	72.66	Mf
Penniscot-Dunklin Electric Coop Hayti Mo	8 W6XIO	153.65	Mf
Phillips Petroleum Co Sweeney Tex	100 W5XCA	33.26	Mf
Phillips Tex	W5XCB	33.26	Mf
Hansford Tex	W5XCC	33.06	Mf
14 & Klein Sts Dumas Tex	W5XCD	33.26	Mf
City Nat Bank Bldg Houston	W5XCW	33.26	Mf
Placid Oil Co 1107 City Bank Bldg Shreveport La	25 W5XVN	37.5	Gr
Potlatch Forests Inc Lewiston Ida	W7XMF	33.34	Gr
Portable-Mobile Putomac Elec Pwr Co 10th & E 8th NW Washington DC	8 W7XMI	153.59	Gr
Pullman-Standard Car Mfg Co 719 Wash Michigan City Ind	9 W9XIN	153.59	Mf
Riverview Farms Box 258 Washington Av Oxford NY	10 W2XTN	153.59	Lf
Robertson-Matheny Oil Co PO Box 3097 Wichita Falls Tex	9 W5XYJ	33.18	Gr
Roosevelt Irrigation Dist PO Box 1089 Buckeye Ariz	2 W7XJG	157.53	At
Seaside Lumber Co 1208 American Trust Bldg Berkeley Calif	3 W6XWO	153.59	a
So Calif Edison Co Ltd Mojave Calif	W6XFN	75.50	Mf
Santa Monica Calif	W6XSZ	75.50	Mf
Santa Paula Calif	W6XTE	75.50	Mf
Nr Corona City Calif	W6XTL	75.50	Mf
Nr San Fernando Calif	W6XTO	75.50	Mf
Nr Ventura Co Calif	W6XTF	75.50	Mf
Southside Elec Coop Inc Crewe Va	W4XNE	75.50	Lf
T B Tripp & Sons 1604 W 2nd St Odessa Tex	20 W5XYN	33.18	Mf
Union Bag & Paper Co Sta Savannah Ga	1 W4XRN	157.11	Bf



TWO-CHASSIS CONSTRUCTION OFFERS HIGHEST QUALITY, MAXIMUM FLEXIBILITY

It's by FISHER! It's the BEST!

The Fisher

DYNAMIC NOISE SUPPRESSOR WIDE RANGE AMPLIFIER

If you seek the finest in dynamic noise suppression, coupled with an amplifier that is precision built to exceptional, laboratory standards, there can only be one choice—THE FISHER Dynamic Noise Suppressor-Wide Range Amplifier,* custom constructed on two chassis. Here is its pedigree:

THE FISHER Wide Range Amplifier

1. A man's size amplifier with only 1% distortion at twenty watts!
2. Intermodulation distortion less than 1/2% at 5 watts output.
3. Uniform response from 20 to 20,000 cycles, plus or minus 1 db.
4. Hum level warranted less than 0.5 microwatts for one watt output.
5. Internal impedance less than 1.25 ohms.
6. 18 db of negative feedback.
7. Phono preamplifier and first audio operated entirely on DC to reduce hum.
8. Phono preamplifier comprises two triode stages operated in cascade, to minimize tube noise.
9. Phono circuit compensated for G. E. and Pickering pickups.
10. Exclusive, two-position pickup compensation for pre-emphasized recordings as well as recordings without rising characteristic at high end.
11. Two, medium gain auxiliary inputs for radio, etc., with selector switch on front panel, for convenience of use.
12. Output impedances 8 and 16 ohms. Professional quality line matching transformer for 125 and 500 ohms available at additional cost. (NOTE: Our experience has shown that it is not practical to design a high quality output transformer including both voice coil and line matching windings.)
13. Push-pull parallel output tubes, for conservative operation and superior output transformer design.

THE FISHER Dynamic Noise Suppressor

1. Incorporates six tubes, for optimum flexibility and effectiveness.
2. Two high frequency gates, dynamically controlled.
3. One switch position (see below) provides fixed filter tuned to 18 Kc. (Readily tuned to 10 Kc. by simple screw adjustment.)
4. Independent control voltage amplifier for operation of gates.
5. Double diode tube to provide DC control voltage for gate circuits.
6. Two cathode ray indicators to show

7. Muting circuit and connecting plug for complete silencing of needle swish in run-off groove and "blop" when the pickup lands on the next record.

GENERAL FEATURES

1. TWO-chassis construction, for optimum electrical performance and ease of installation in limited space—without undesirable long leads. Chassis constructed of 16-gauge steel.
2. Power available for external microphone preamplifier, etc., 250 volts at 50 ma, DC and 6.3 volts at 3 amperes AC.
3. SEVEN CONTROLS. (a) Volume Control. (b) Three-position switch for phono and two auxiliary inputs. (c) Six-position, On-Off and Range Switch (20-20,000 cycles, 20-10,000 cycles, 70-4000 cycles*, 90-3200 cycles*, 120-2700 cycles*). *Frequency response with gates fully closed position. With gates fully open, response is that in position 2, except that in position 3 response is limited to 6000 cycles. (d) Treble Control, continuously variable with maximum boost 16 db at 10,000 cycles, maximum cut 20 db at 10,000 cycles. (e) Bass Control, continuously variable with maximum boost 16 db at 100 cycles, maximum cut 32 db at 20 cycles. (f) Gate Sensitivity Control on front panel. Varies dynamic range of suppression for positions 3 to 5 of Range Switch and permits optimum adjustment for various input levels and background noise characteristics, instantly and easily. (g) Phono Equalization Switch, two-position.
4. Tube Complement. Suppressor-Voltage Amplifier Chassis: 2-12AT7, 1-6C4, 3-6BA6, 1-6AL5, 1-6AQ8, 2-6E3. Panel: 10Y3* x 19", height 8 3/4", width 13", depth 8". Power Chassis: 4-7C5, 1-7A4, 2-5Y3. Panel: 8 3/4" x 19", height 7 1/4", width 14 1/2", depth 8 1/2".
5. Auxiliary AC Outlets. Two available, for tuner, turntable, etc., controlled by master On-Off Switch.
6. Jewel pilot light on front panel.

*Licensed under Hermon Hosmer Scott patents pending for use only in phonograph and phonograph distribution systems.

PRICE \$254.50 • LIMITED QUANTITY AVAILABLE FOR IMMEDIATE DELIVERY
FISHER RADIO CORPORATION • 39 EAST 47TH ST., NEW YORK

*A New ERA
in the Great Southwest!*

WFAA-FM

(formerly KERA)

First FM station in the Southwest's Biggest
Billion Dollar Market — Dallas and Fort
Worth — operating nine hours daily
with 14,000 watts radiated power.

97.9 Mc.

WFAA-FM

Channel 250

A RADIO SERVICE OF THE DALLAS MORNING NEWS

Dallas, Texas

WASH—FM— WASHington, D. C.

ORIGINATING STATION
FOR THE

Continental Network

Featuring regular live-talent broadcasts by

U. S. AIR FORCE CONCERT ORCHESTRA.....THURS. 9-10 p.m.
U. S. ARMY BAND.....WED. 8-9 p.m.
ROCHESTER CIVIC ORCHESTRA.....FRI. 8:30-9 p.m.
GENE ZACHER'S DANCE ORCHESTRA.....FRI. 8-8:30 p.m.
U. S. NAVY BAND.....MON. 8-9 p.m.
HOTEL CARLTON CONGO-ROOM DANCE BAND.....TUES. 8:30-9 p.m.

On the air since 1945 with interim power

15000 watt installation nearing completion

EVERETT L. DILLARD, General Manager

EXP. UTILITIES & INDUSTRIAL — Continued

United Gas Pipe Line Co 1525 Fairfield Av	W5XLK	72.66	Mf
Shreveport La	W4XXO	72.66	Lf
Va Gas Transmission Corp 1033 Quarter St	W4XXO	72.66	Lf
Washington DC	6 WIOXXL	153.50	Ba
Westinghouse Radio Stations 1619 Walnut	5 W8XCG	37.14	Mf
Philadelphia Pa	2 W7XNL	33.26	Lf
Weyerhaeuser Timber Co PO Box 812			
No Bend Ore			

GEOPHYSICAL

Amerada Petrol Corp 120 Bway	6 KIHA	1.700	Kf
New York NY	19 KCJW	1.676	a
American Exploration Co 1108 Van Buren St	4 KITU	1.676	a
Houston Texas	2 KEKA	1.602	a
Apache Exploration Co 1452 Esperson Bldg	4 KKOP	1.652	a
Houston Tex	3 KUJK	35.06	f
Arkansas Fuel Oil Company Slattery Bldg	5 KQMF	1.676	Ka
Shreveport La	2 KRRT	1.676	a
Atlantic Refining Co 260 S Broad St	2 KRQD	1.676	a
Philadelphia Pa	8 KFYH	1.676	a
Atlas Exploration Co Meille Esperson Bldg	2 KRYJ	35.06	a
Houston Tex	2 KEKA	1.602	a
Wm M Barret Inc Giddens-Lane Bldg	4 KKOP	1.652	a
Shreveport La	3 KUJK	35.06	f
Shreveport La	5 KQMF	1.676	Ka
Sol Bronstein 1820 W Franklin St	2 KRRT	1.676	a
Evansville Ind	2 KRQD	1.676	a
Carr Geophysical Co Commerce Bldg	4 KKOP	1.652	a
Houston Tex	3 KUJK	35.06	f
S Chapman Dept of Physics	5 KQMF	1.676	Ka
Stanford Univ Calif	2 KRRT	1.676	a
Cities Service Oil Co Masonic Bldg	3 KQMF	1.676	Ka
Bartlesville Okla	2 KRRT	1.676	a
J O Clark Jr Oil Explorations PO Box 565	3 KKITO	1.676	Ka
Mission Tex	9 KAHH	1.676	Ka
Continental Oil Co	4 KBVA	35.54	Lf
Ponca City Okla	4 KKKY	35.06	f
Ponca City Okla	2 KRRT	1.676	a
Crowell & Steele Inc 3416 Ella Lee Lane	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Geophysical Development Corp 1249 S Boston	3 KKITO	1.676	Ka
Tulsa Okla	3 KKITO	1.676	Ka
Geophysical Eng Corp 199 S Fair Oaks Av	3 KKITO	1.676	Ka
Pasadena Calif	3 KKITO	1.676	Ka
Geophysical Exploration Co 104 Bway	3 KKITO	1.676	Ka
Denver Colo	3 KKITO	1.676	Ka
Geophysical Research Corp 120 Bway	3 KKITO	1.676	Ka
New York NY	3 KKITO	1.676	Ka
Geophysical Service Inc 1311 Republic Bk Bldg	3 KKITO	1.676	Ka
Dallas Tex	3 KKITO	1.676	Ka
Geotechnical Corp 3712 Haggar Drive	3 KKITO	1.676	Ka
Dallas Tex	3 KKITO	1.676	Ka
Gulf Research & Dev Co PO Drawer 2038	3 KKITO	1.676	Ka
Pittsburgh Pa	3 KKITO	1.676	Ka
Humble Oil & Refining Co 1216 Main St	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Independent Exp Co Esperson Bldg	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Interstate Petrol Comm Inc 30 Rockefeller Pl	3 KKITO	1.676	Ka
New York NY	3 KKITO	1.676	Ka
New York NY	3 KKITO	1.676	Ka
Keystone Exploration Co 2813 Westheimer Rd	3 KKITO	1.676	Ka
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Magnolia Petroleum Co Magnolia Bldg	3 KKITO	1.676	Ka
Dallas Tex	3 KKITO	1.676	Ka
McAllum Exploration Co Esperson Bldg	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Natl Geophysical Co Tower Petroleum Bldg	3 KKITO	1.676	Ka
Dallas Tex	3 KKITO	1.676	Ka
Dallas Tex	3 KKITO	1.676	Ka
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Petty Geophysical Eng Camp 317 6th St	3 KKITO	1.676	Ka
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Dallas Tex	3 KKITO	1.676	Ka
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Southern Geophysical Co Sinclair Bldg	3 KKITO	1.676	Ka
Fort Worth Tex	3 KKITO	1.676	Ka
Fort Worth Tex	3 KKITO	1.676	Ka
Fort Worth Tex	3 KKITO	1.676	Ka
Stanolind Oil & Gas Co 5th & Boston Sts	3 KKITO	1.676	Ka
Tulsa Okla	3 KKITO	1.676	Ka
Tulsa Okla	3 KKITO	1.676	Ka
Tulsa Okla	3 KKITO	1.676	Ka
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Beaumont Tex	3 KKITO	1.676	Ka
Beaumont Tex	3 KKITO	1.676	Ka
Superior Oil Co 400 Oil & Gas Bldg	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Houston Tex	3 KKITO	1.676	Ka
Texas Co 135 E 42nd St	3 KKITO	1.676	Ka
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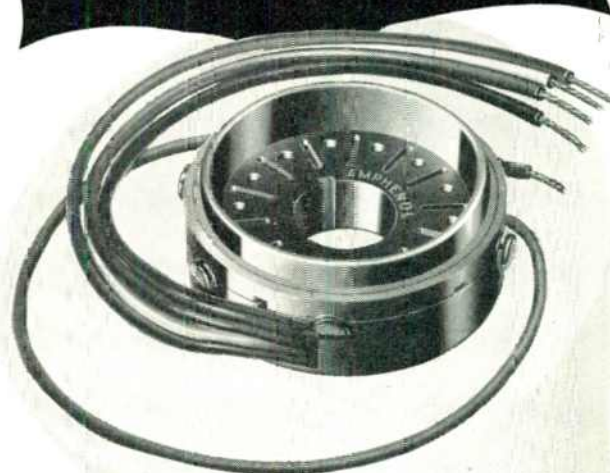
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WHAT'S NEW THIS MONTH

(CONTINUED FROM PAGE 15)

work service by the end of 1948 if the demand exists."

(5) NEW YORK AND CHICAGO: "Coaxial cable is expected to be completed between New York and Chicago by the fall of 1948 and television circuits can be provided over that route shortly thereafter."

(6) CHICAGO AND ST. LOUIS: "It is expected a connection could be provided between Chicago and St. Louis by the fall of 1948, by means of coaxials through Terre Haute."

(7) LOS ANGELES AND SAN FRANCISCO: "Television facilities between Los Angeles and San Francisco are expected to be available in 1949."

It can be seen from the above quotations that the American Telephone and Telegraph Company on its own initiative had made definite plans for a far flung network of television stations; but despite the tremendous growth of FM, had no similar plan for FM networks, even though a present demand existed for such facilities.

11. It is also noteworthy that *no charge has been made by the American Telephone and Telegraph Company for the use of these network facilities for television broadcasting* for either sustaining or commercial broadcasts in those communities where television stations now operate inter-city. By contrast, a request for the use without charge of the Washington to New York facility for FM network purposes was denied by the American Telephone and Telegraph Company.

12. PETITIONER THEREFORE REQUESTS:

A. That the Commission pursuant to Section 205(a) of the Communications Act make an investigation to determine whether there has been compliance with the provisions of Section 202(a).

B. That this petition be regarded as an informal complaint pursuant to Section 208 of the Communications Act, and Sections 1.572 and 1.573 of the Rules and Regulations; and that these questions be taken up by the Commission with the American Telephone and Telegraph Company in an effort to bring about satisfaction.

C. That a hearing be held regarding the establishment of common carrier facilities for FM network operation and following such hearing that the Commission prescribe just and reasonable charges for the service desired by FM broadcasters.

D. That until such time as reasonable rates and charges are fixed, to order the respondent, American Telephone and Telegraph Company, to afford FM broadcasters the use of facilities for network purposes on the same basis as presently used by television broadcasters.

Respectfully submitted,

LEONARD H. MARKS

General Counsel

FM Association

December 13, 1947

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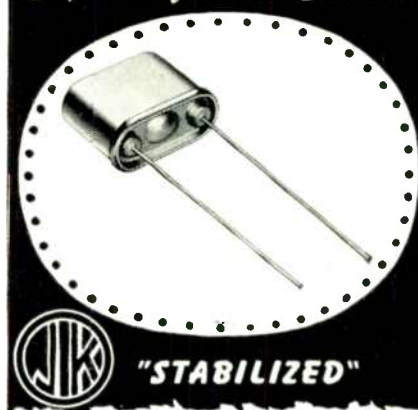
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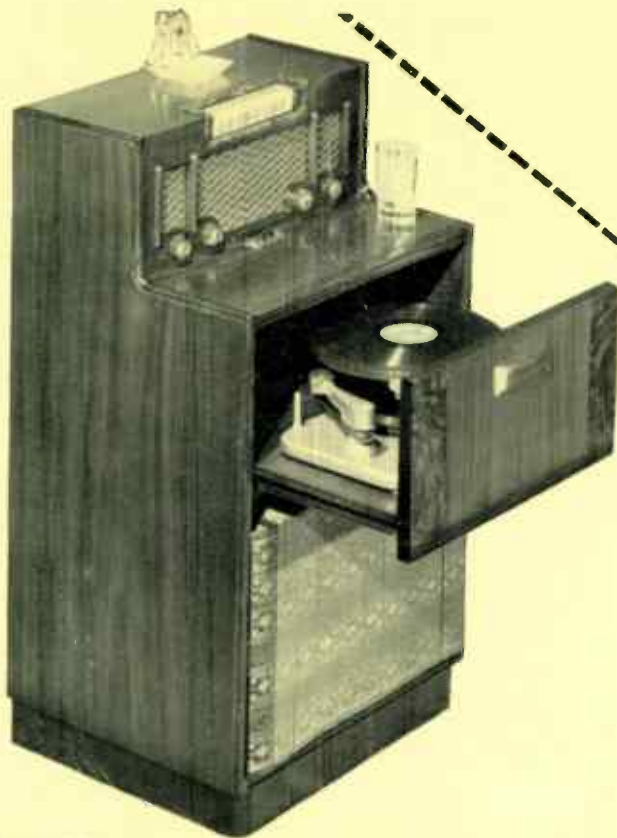
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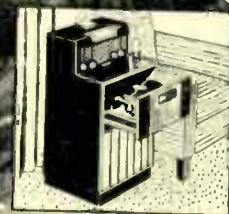
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